



CO-EXIST

Responsible mining. Sustainable fisheries.

EPA Overview

**John Shively/CEO
Ken Taylor, Vice President, Environment**

June 2, 2011



The Pebble Partnership

A Shared Commitment to Sustainable Development
and Social and Community Responsibility.

Northern Dynasty has delineated one of the world's great orebodies, assembling one of the most extensive environmental databases in the history of resource development.

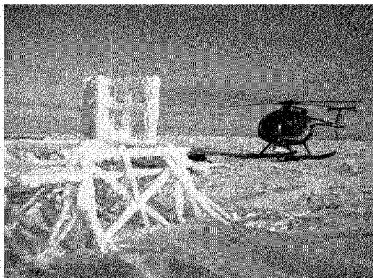
Anglo American US brings a depth of corporate resources and a successful track record of global leadership in modern mining practices.

www.pebblepartnership.com



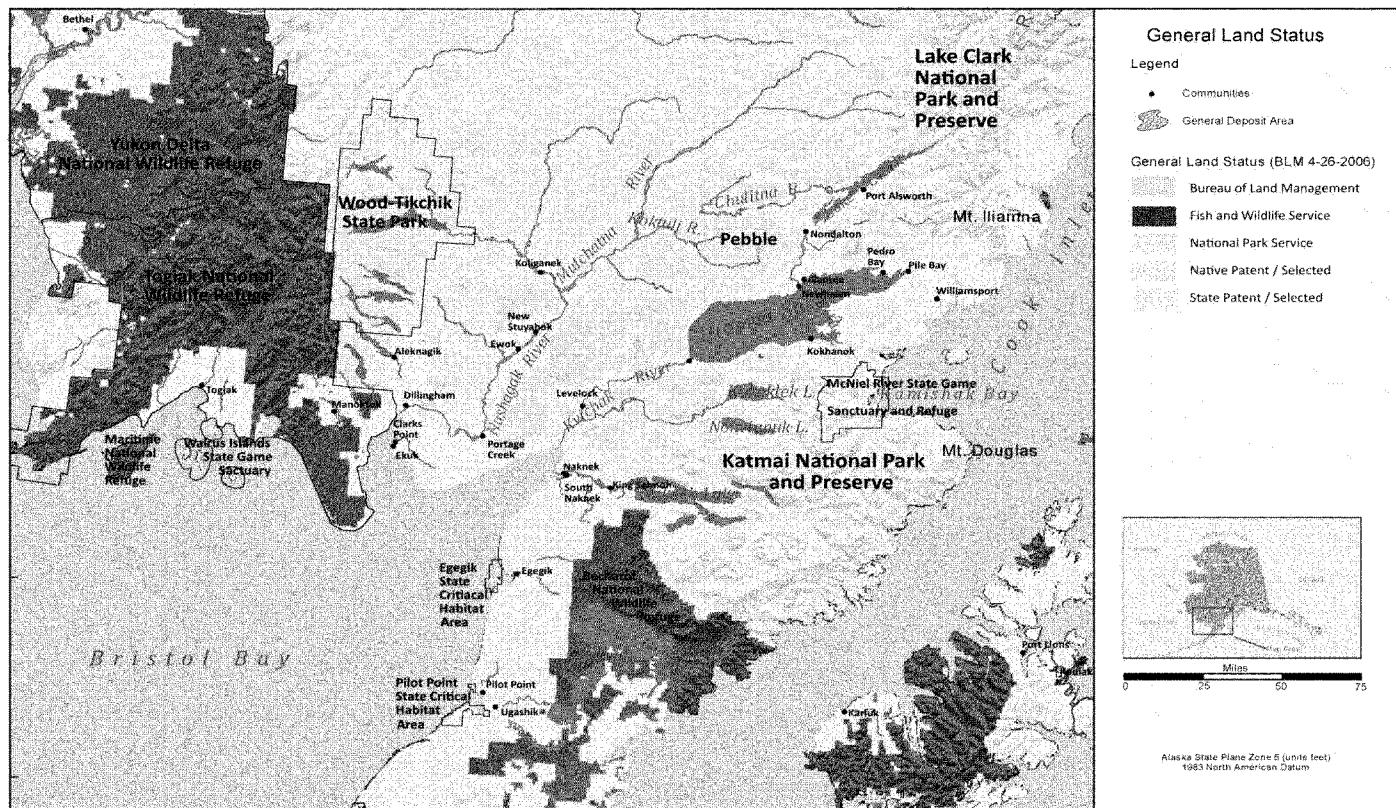
Five Core Principles

- Benefit people – it is for Alaskans
- Co-exist with the environment
- Apply the world's best and most advanced science
- Help build sustainable communities
- Listen before we act





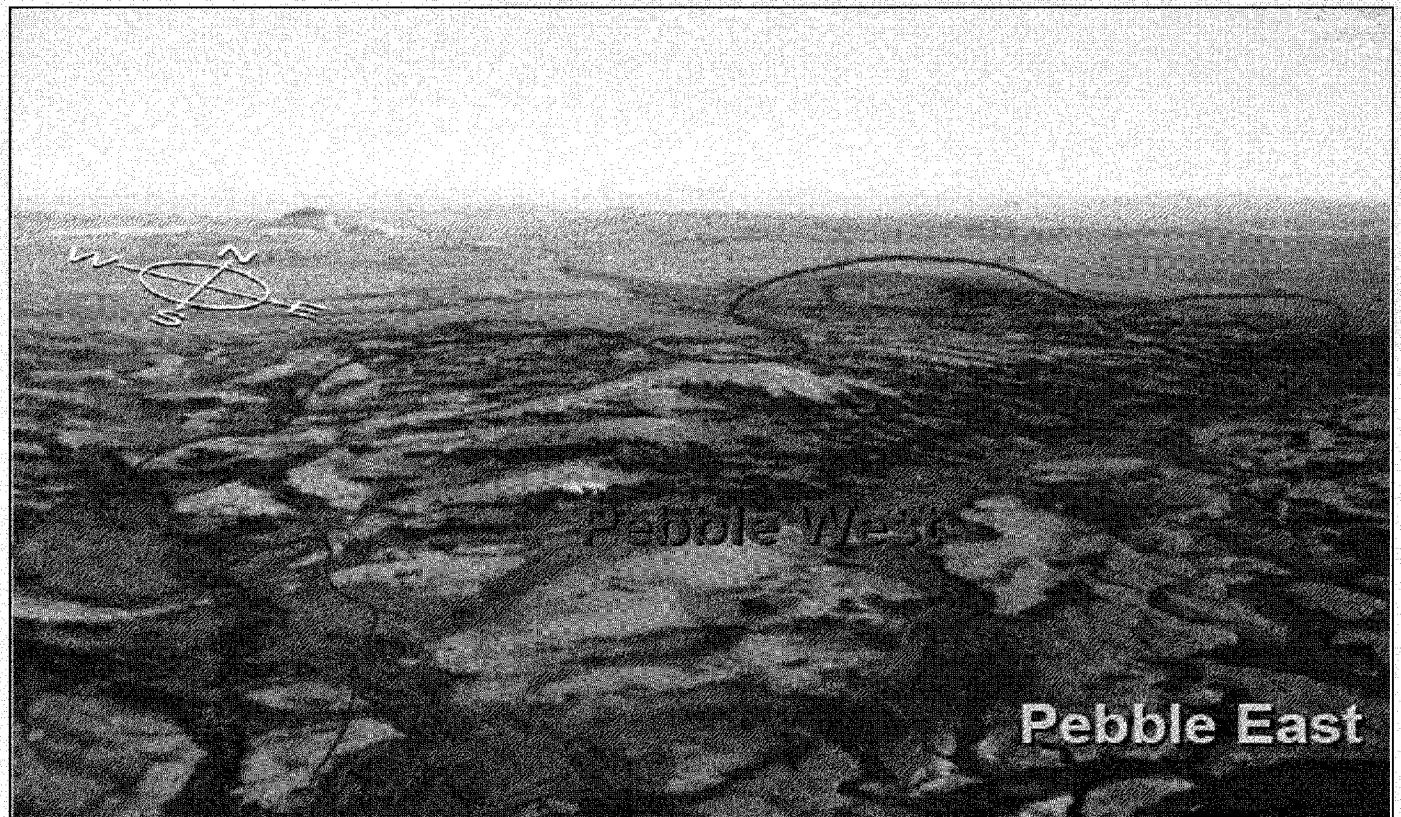
Land Classifications



EPA-7609-0005231-0004



Pebble Deposit Topography



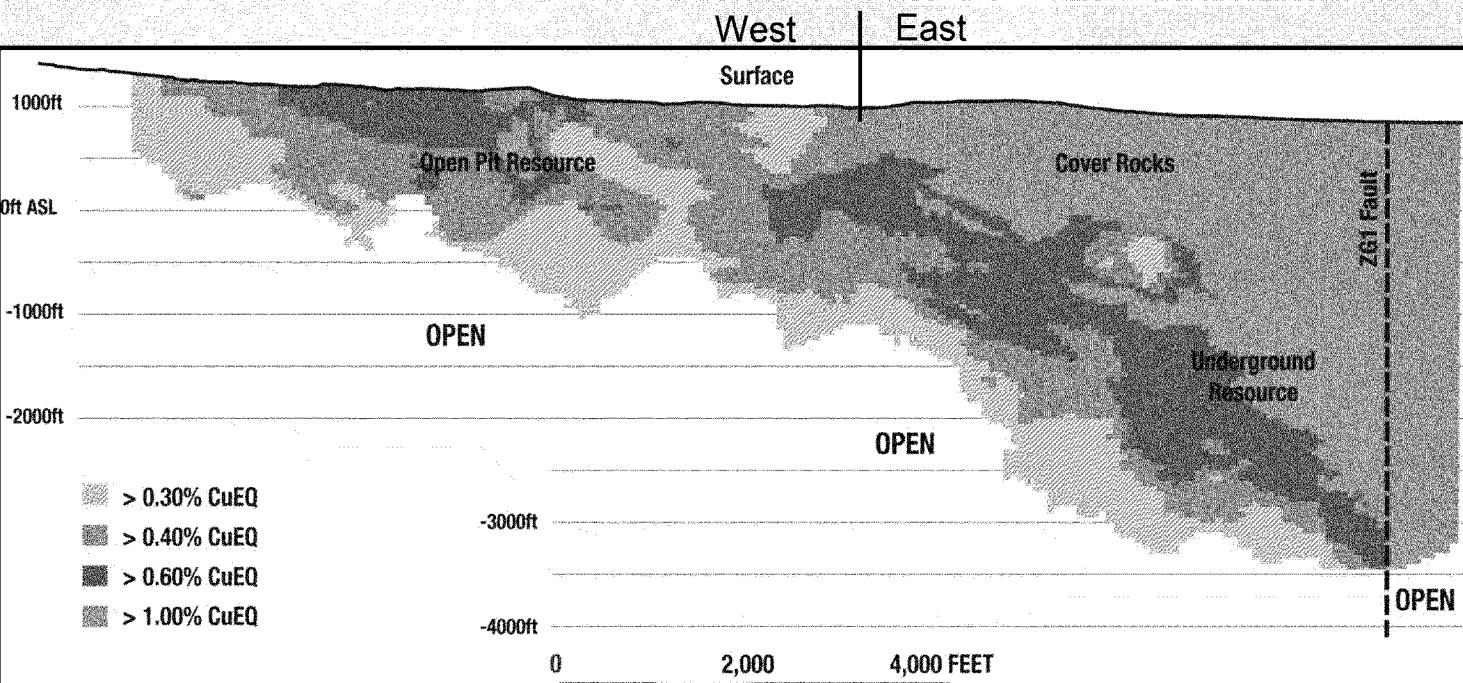
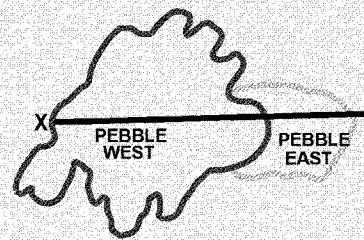
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Pebble Deposit

Total In-Situ Resource:

- 80.6B lbs Copper
- 5.6B lbs Molybdenum
- 107.4M ounces Gold



EPA-7609-0005231-0006



Minimal Footprint Exploration



EPA-7609-0005231-0007

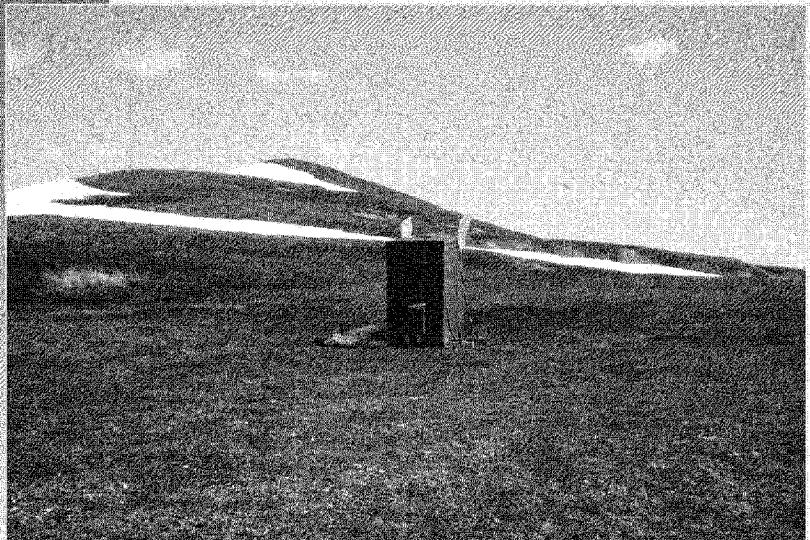
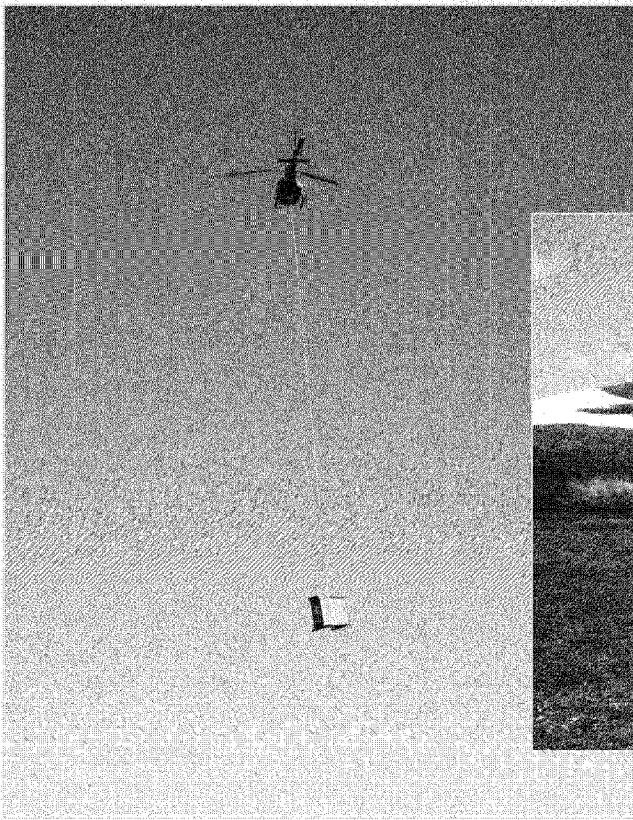


Reclamation Begins Immediately





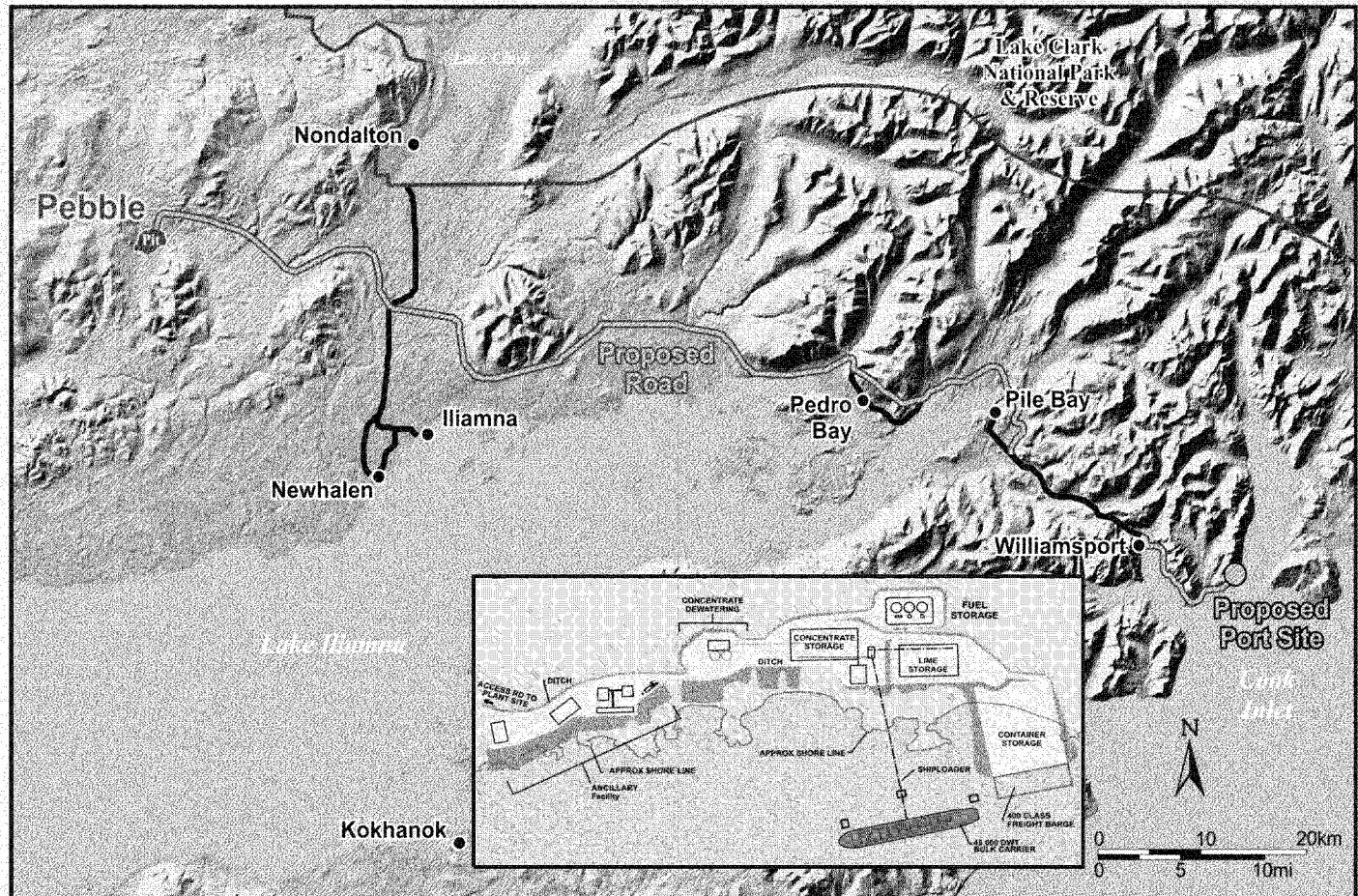
Minimal impact



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Infrastructure



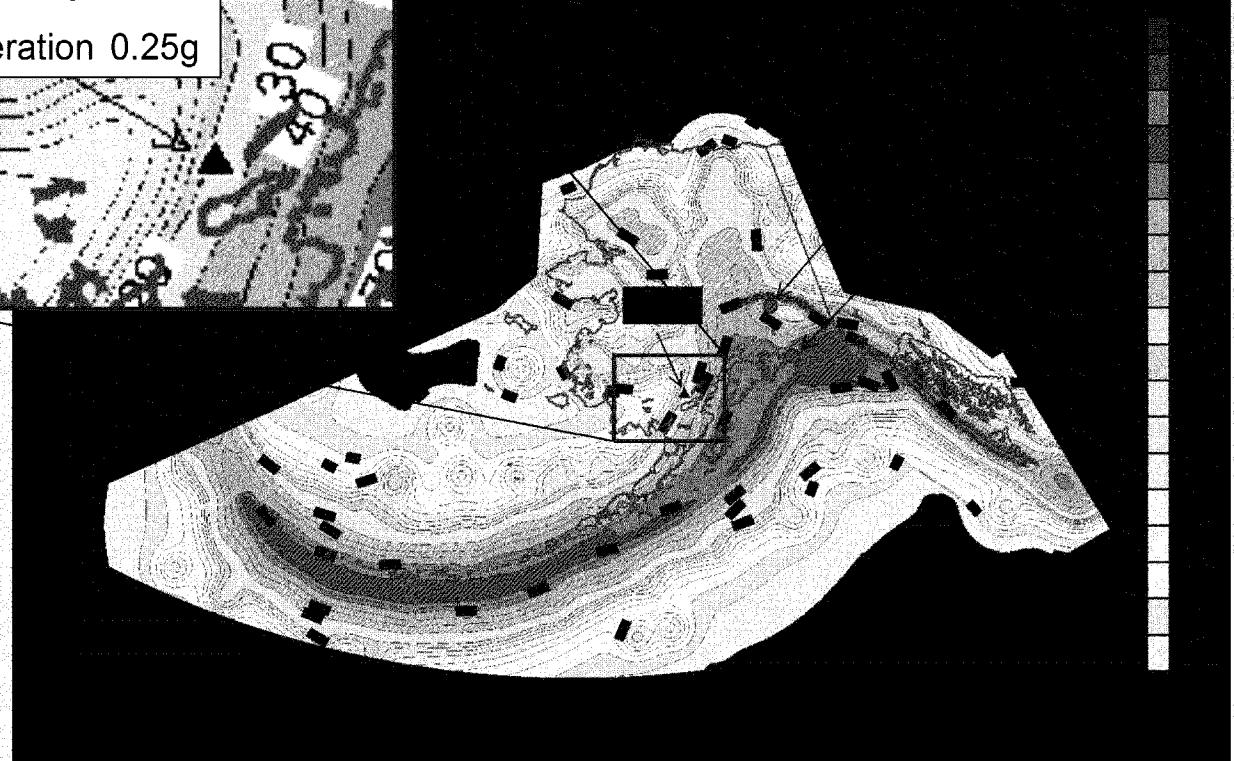
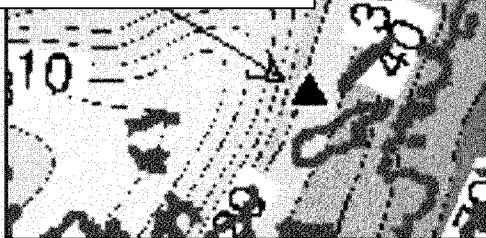
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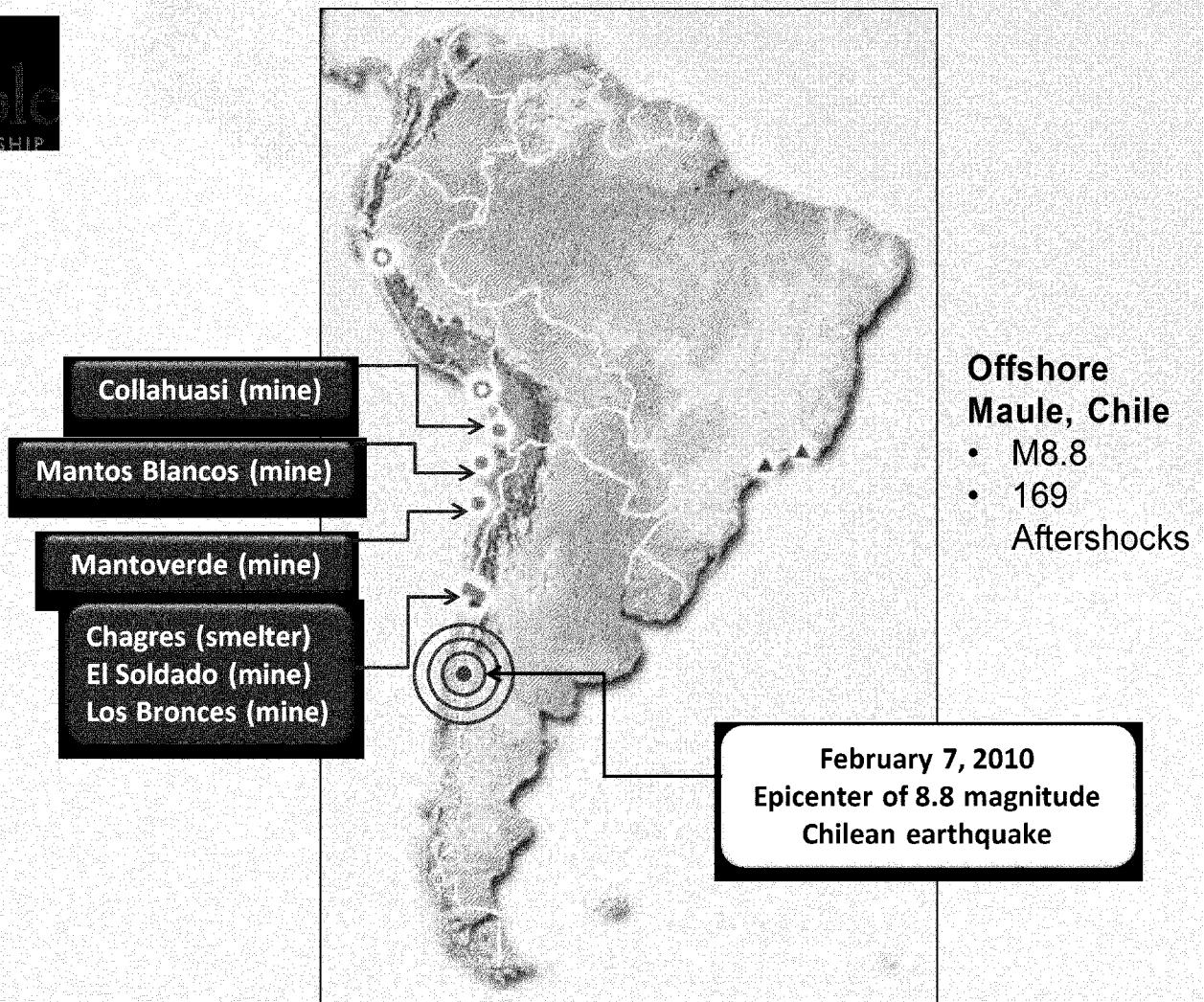
Seismicity



Pebble Project

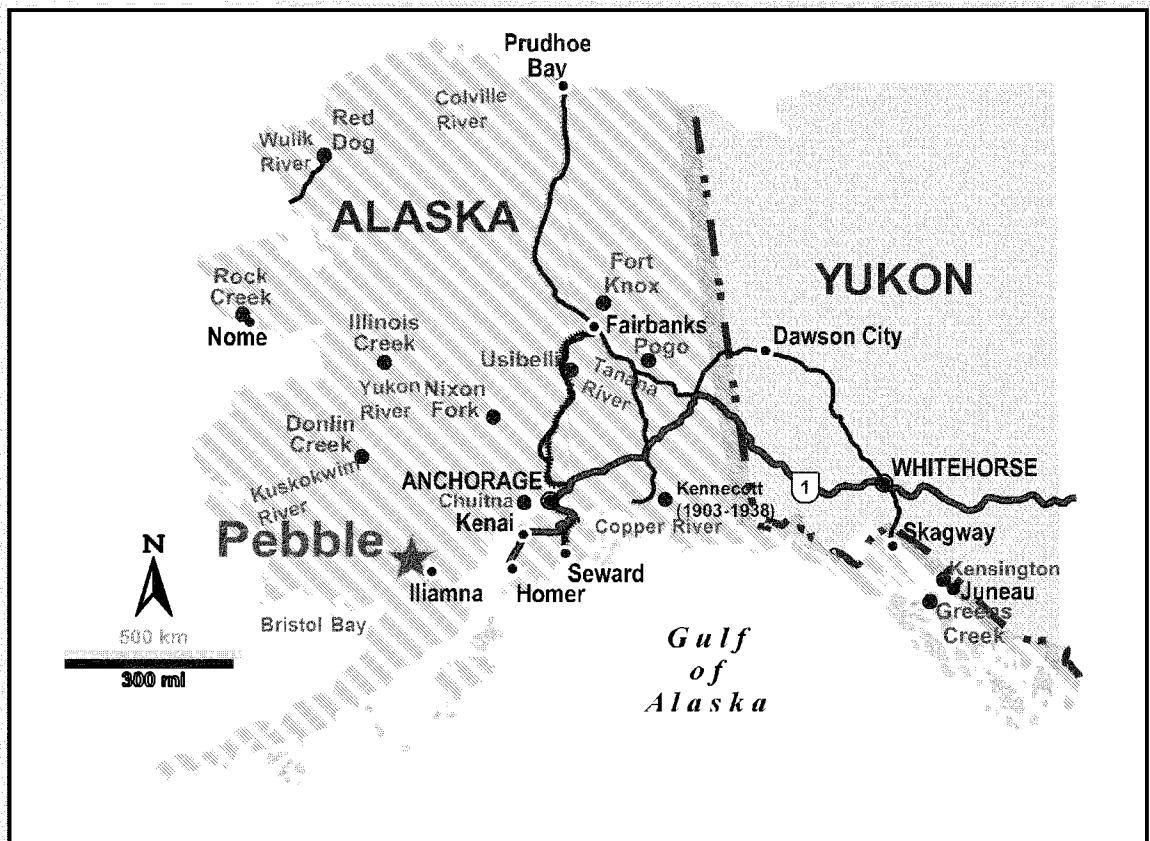
acceleration 0.25g







Mining & Fishing Co-Exist

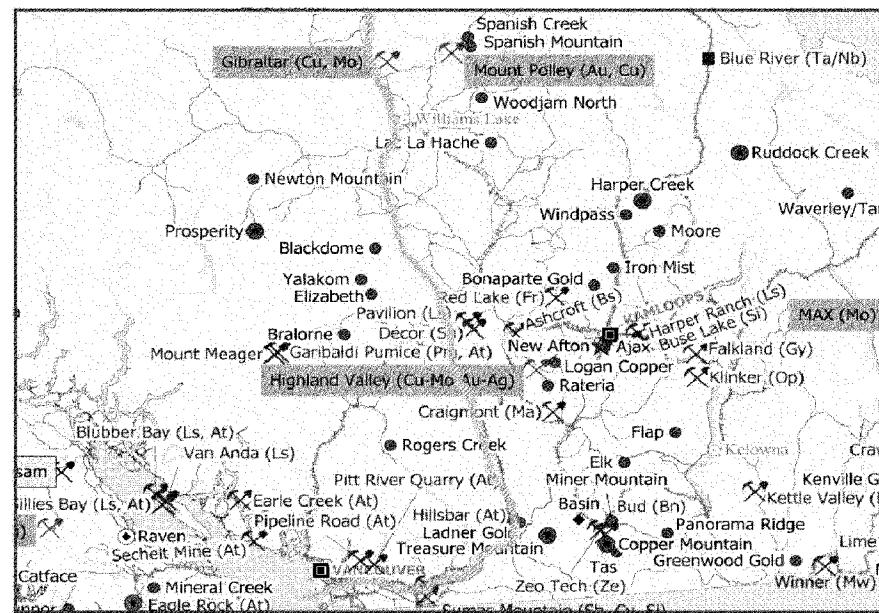


Slide from J. Lang, 2009

EPA-7609-0005231-0013



Partial Fraser River Basin



Operating Mines and Selected Major Exploration Projects in British Columbia 2009

D. Grieve, B. Madu, B. Northcote, P. Wojdak,
J. Fredericks, S. Meredith-Jones, & P. Saunders

Open File 2010-1

Mines and Quarries

- 8 X Metal Mine
- 9 X Coal Mine
- 36 X Industrial Mineral

- 2 ★ Metal Mine Development

Proposed Mine Developments

- 17 ● Metal
- 8 ● Coal
- 3 ● Industrial Mineral

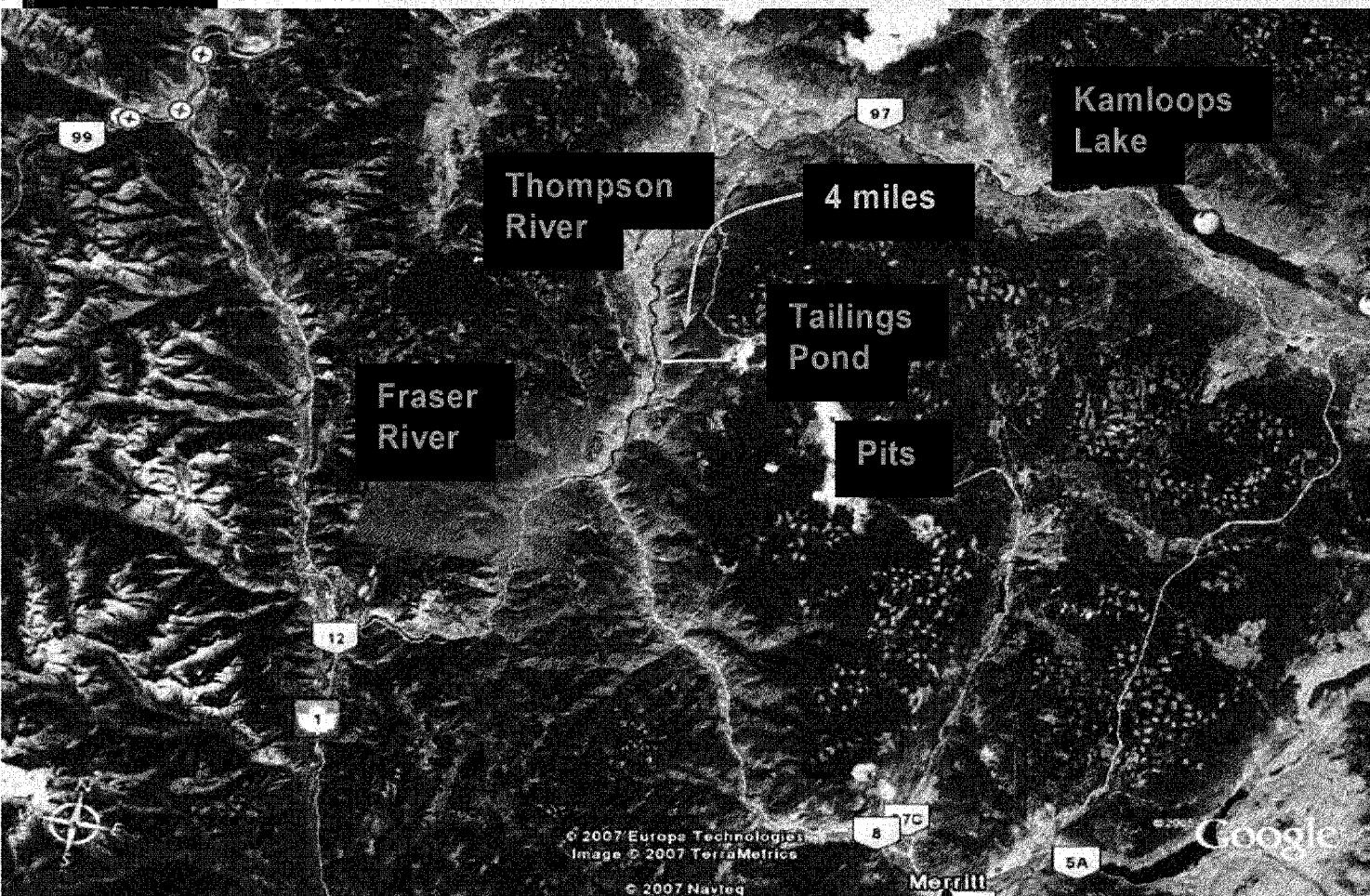
Selected Major Exploration Projects

- 78 ● Metal (includes Myra Falls)
- 7 ● Diamond (includes Gething, Mount Michael and Raven)
- 5 ■ Industrial Mineral

Metal Mine commodity code	
Al - Aluminum	As - Zinc
Br - Barite	Cu - Copper
Fe - Magnetite	Mo - Molybdenum
Industrial Mineral commodity code	
Ag - Silver	Ba - Barite
Ca - Calcium	Cr - Cobalt
Cl - Chlorite	Fe - Chalcocite
Li - Lithium	Fr - Fluorite
Na - Magnesite	Ga - Gallium
Mg - Magnesite	K - Potassium
Mo - Molybdenum	Nb - Niobium
Na - Sodium	P - Phosphate
Si - Silicon	Pr - Praseodimium
Sp - Spodumene	Ta - Tantalum
St - Strontium	Zn - Zinc



Highland Valley Mine



EPA-7609-0005231-0015



Environmental Study Requirements

- Annual study plans - each consultant
- Quality Assurance Project Plan
- 3 levels quality assurance/quality control



Environmental Studies

- Surface Water
- Water Quality
- Groundwater
- Geochemistry
- Snow Surveys
- Analytical QA/QC
- Fish & Aquatic Resources
- Macroinvertebrates
- Wetlands
- Trace Elements
- Flow Habitat Study
- Iliamna Lake Study
- Marine
- Wildlife
- Air Quality
- Noise
- Cultural Resources
- Subsistence
- Land Use
- Recreation
- Socioeconomics
- Visual Aesthetics
- Impact assessment & management
- Mine closure & reclamation



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Water Balance



Water quantity

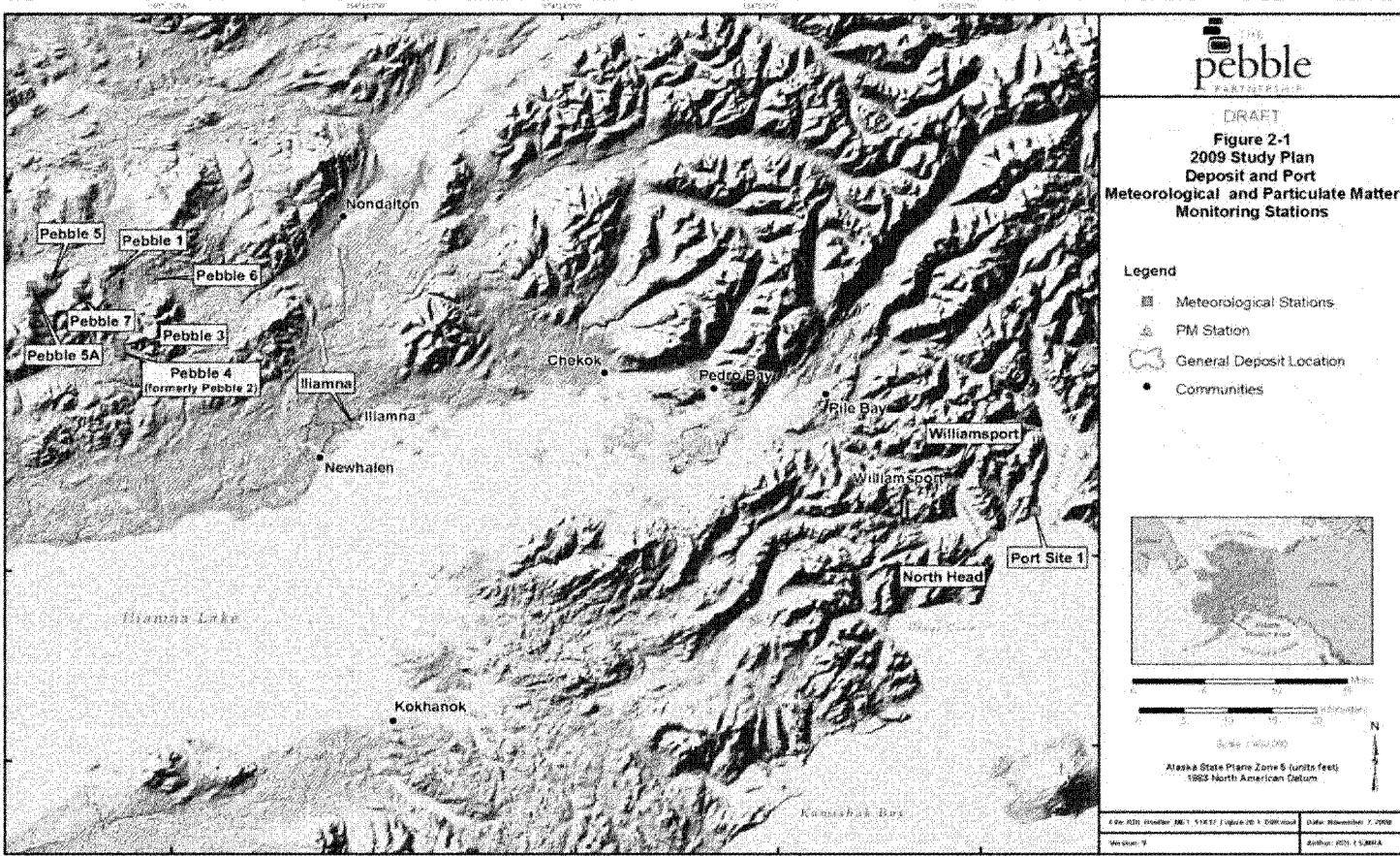
- Power generation, concentrate to port, camp consumption, tailings impoundment
- Treatment and discharge
- When, where and how much to optimize fish habitat

Studies

- Meteorology
- Surface Hydrology
- Ground Water Hydrology
- Snow Measurements



Meteorological Station Locations



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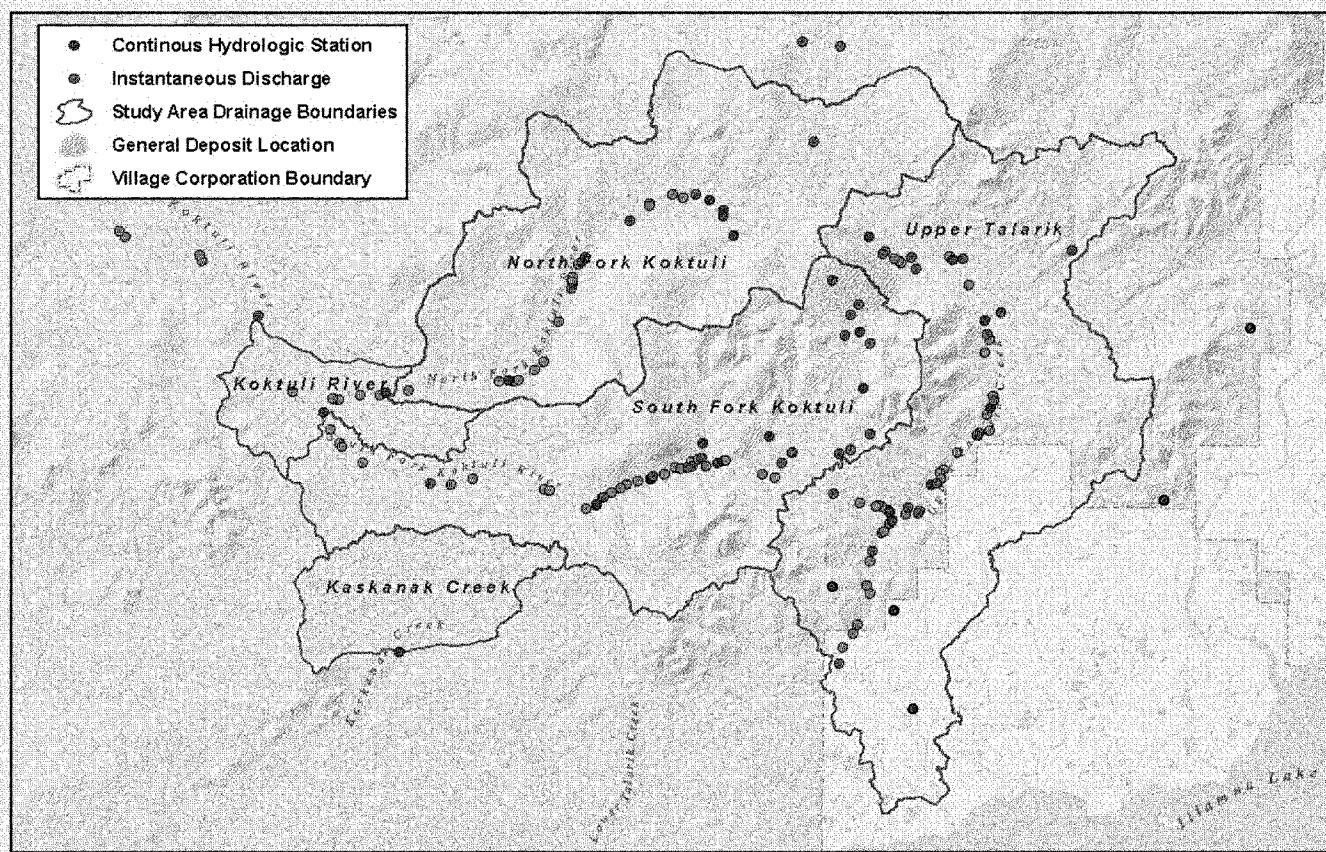
Hydrology Studies



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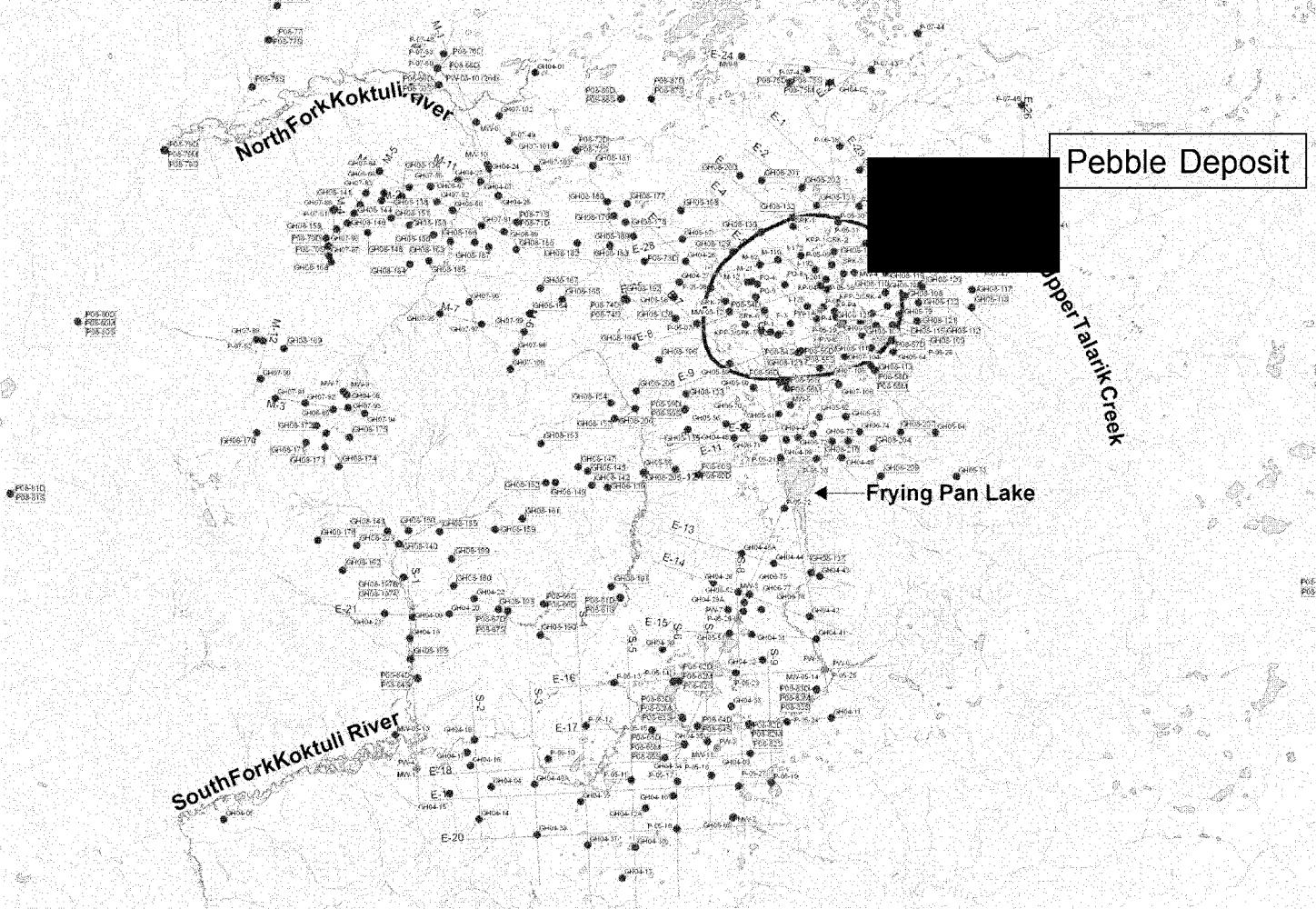
All Flow Measurement Locations



EPA-7609-0005231-0021

2004 - 2008

400+ Groundwater Monitoring Stations



EPA-7609-0005231-0022



Piezometer Installations Summary

DRAINAGE	2004	2005	2006	2007	2008	TOTAL
South Fork Koktuli in deposit area	31	31	6	8	26	102
South Fork Koktuli remainder	37	41	3	-	61	142
North Fork Koktuli	12	1	4	29	70	116
Upper Talarik	6	11	13	5	27	62
Small Pools Study	-	21	-	29	-	50
Total	86	105	26	71	184	472
Total Groundwater Level Measurements						14,787



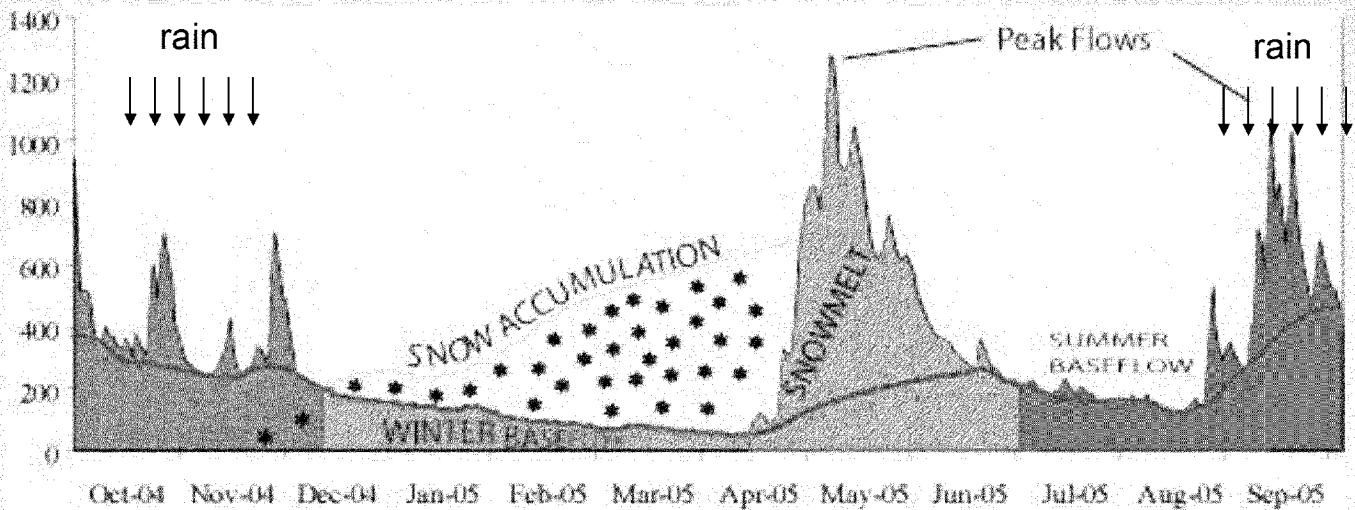
Snow Surveys 2004 - 2008

- Critical component for water balance modeling
- Snow cores up to 120 inches extracted and weighed, with snow-water equivalent as high as 46 inches.



Baseflow Fieldwork

- 41 Stations
- Instantaneous Measurements





Water Quality Program

History & Scope

- Seven years water quality data
 - Monthly data
 - Winter slightly less frequency in early years
 - Quarterly 2010
- Approx. 49 sampling events per site/long term sites
- Number of stations changes over time
 - Range of 20-30 stations
- Extensive list of parameters



Water Quality Parameters

Streams, Seeps, GW

- *Discontinued Effective April 2009 (streams only):*
 - As, B, Ba, Be, Bi, Ca, Co, Cr, Mg, Mo, Ni, K, Se, Si, Ag, Na, Tl, Sn, V,
 - Specific conductance,
 - acidity,
 - ammonia,
 - chloride,
 - total cyanide,
 - fluoride,
 - nitrite, nitrate,
 - phosphorus,
 - sulfate,
 - thiocyanate
- *Being retained:*
 - Al, Sb, Cd, Co, Cu, Fe, Hg, Pb, Mn, Ni, Zn.
 - Weak Acid Dissociable cyanide
 - pH,
 - hardness,
 - Total Dissolved Solids,
 - Total Suspended Solids,
 - Dissolved Organic Carbon
 - Total Organic Carbon

Water Quality



	Environmental Baseline Program Samples Collected per Year							Total # Samples	Total Lab Results
	2004	2005	2006	2007	2008	2009	2010		
Total Surface Water Quality Samples	418	600	556	1,260	651	440	97	3,395	116,623
Total Groundwater Quality Samples	60	160	177	169	185	156	138	751	73,976
Total Marine Water Quality Samples	9				32			41	1,774
Total Water Quality Samples	487	760	733	1,429	868	596	235	4,187	192,373

Wetlands Studies



17,000
field plot
surveys
completed
in project
area

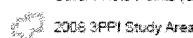


Three Parameters Plus, Inc.
3PPI and HDR 2004 - 2008
Field Plot Locations
DRAFT

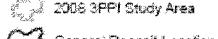
Legend

3PPI and HDR 2004 - 2008
Field Plot Locations (10/28/2008)

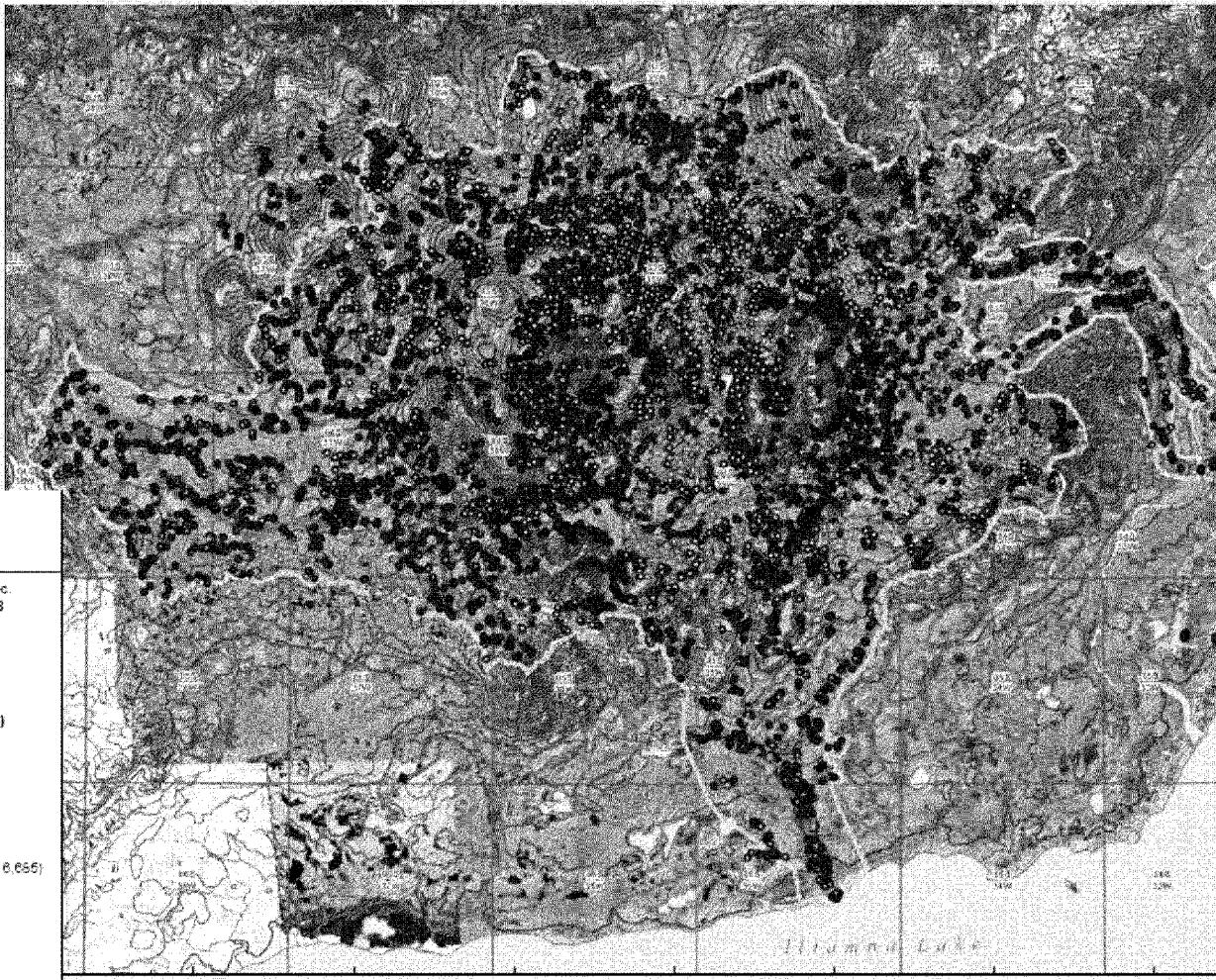
- JD (Count 4,554)
- SH (Count 2,487)
- FA (Count 932)
- SC (Count 1,670)
- WB (Count 2,237)
- Other Photo Points (Count 6,665)



2008 3PPI Study Area



General Deposit Location



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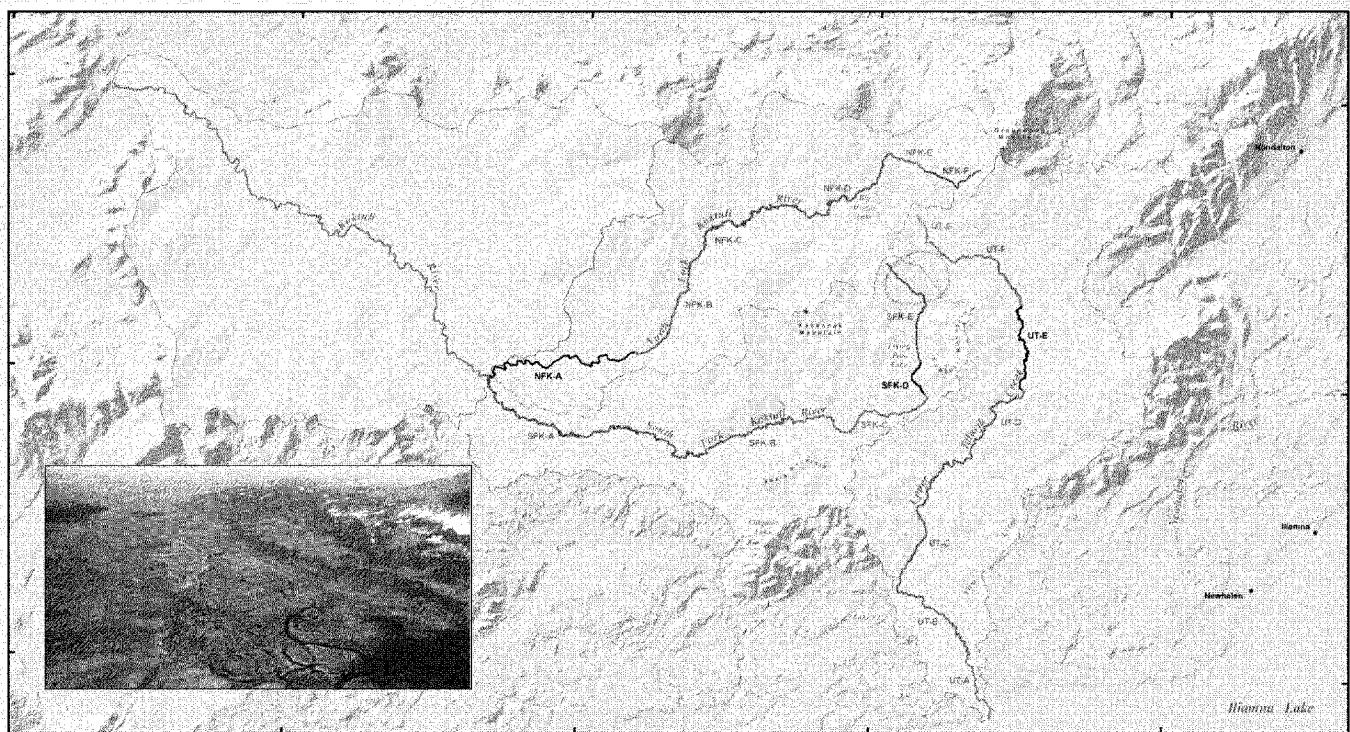


Trace Element Analyses

	Environmental Baseline Program Samples Collected per Year							Total # Samples	Total Laboratory Results
	2004	2005	2006	2007	2008	2009	2010		
Soil and Sediment	321	270	124	85	333	0	2	1,135	29,729
Plants	296	253	338	387	12	0	0	1,286	38,869
Fish	316	311	60	83	119	0	3	892	11,785
Shellfish	15	9	7	1	10	0	0	42	750
Total	948	843	529	556	474	0	5	3,355	81,133



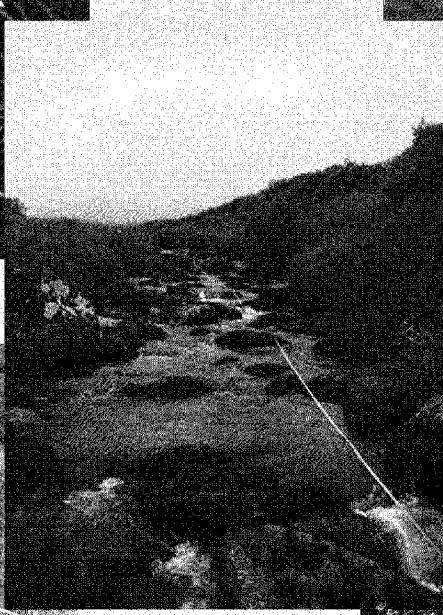
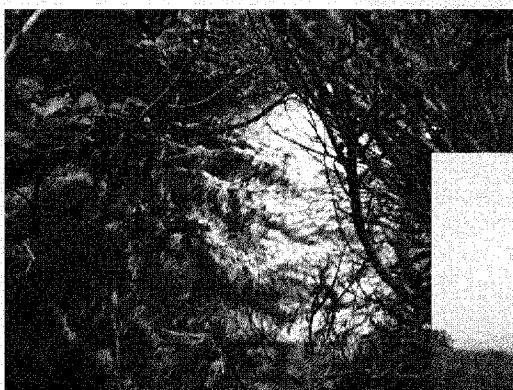
Mine Study Area



EPA-7609-0005231-0031



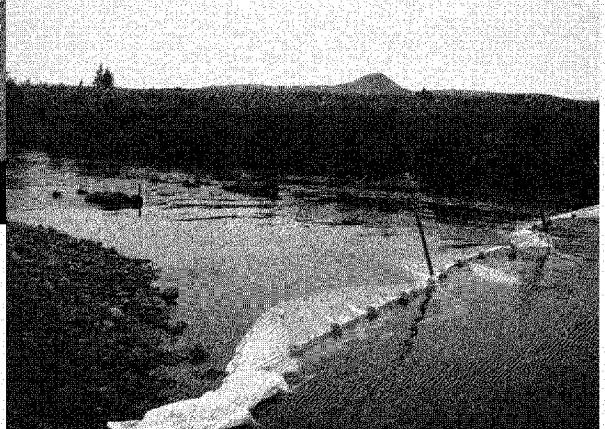
Aquatic Habitat Surveys



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Relative Fish Abundance Surveys



EPA-7609-0005231-0033



Aerial Spawning Surveys



EPA-7609-0005231-0034



Off-channel Habitat Surveys



EPA-7609-0005231-0035



Upper Extent: Fish Distribution in each Tributary



EPA-7609-0005231-0036



Fish Resource Studies by Major Study Category Conducted within the Mine Study Area Watersheds and Transportation Corridor, 2004-2010

Investigation	Year						
	2004	2005	2006	2007	2008	2009	2010
AQUATIC HABITAT ASSESSMENTS							
Mainstem and Tributary Habitat Surveys	NK, SK, UT	SK, UT		UT	NK, SK, UT		
Off-Channel Habitat Surveys					NK		
Mesohabitat Mapping Field Surveys		NK, SK, UT		NK, SK, UT			
Fish/Habitat Associations - Anecdotal Data Collection	NK, SK, UT	K, NK, SK, UT	K, NK, SK, UT	K, NK, SK, UT			
FISH ASSEMBLAGE SURVEYS							
Fish Distribution and Relative Abundance Surveys	K, NK, SK, UT	K, NK, SK, UT					
Fish Use of Off-Channel Habitats Study		SK	SK	SK, UT	NK		
Winter Fish Study	K, NK, SK, UT	NK, SK, UT	NK, SK, UT	SK, UT			
Mainstem Index Surveys	NK, SK, UT	NK, SK, UT			NK, SK, UT	NK, SK, UT	
Adult Salmon Surveys	K, NK, SK, UT	NK, SK, UT		UT			
Tower Escapement Counts						UT	
Rainbow Trout Radio Telemetry Study ^a				UT-Lake Iliamna	UT-Lake Iliamna	UT-Lake Iliamna	
INSTREAM FLOW HABITAT STUDIES							
Mainstem Channel Flow Habitat Studies	K, NK, SK, UT	K, NK, SK, UT		K, NK, SK, UT	NK, SK, UT	NK, SK, UT	SK, UT
Off-Channel Flow Habitat Studies		SK	SK	UT	NK		
Water Temperature Monitoring/Modeling	NK, SK, UT	NK, SK, UT	NK, SK, UT	NK, SK, UT	NK, SK, UT	NK, SK, UT	NK, SK, UT
Fluvial Geomorphology and Spawning Gravel Quality		SK, UT		K, NK, SK, UT	NK, SK, UT		
TRANSPORTATION CORRIDOR STUDIES ^b							
Aquatic Habitat and Fish Assemblage Surveys	X	X		X	X		X

^a The rainbow trout radio telemetry study was centered around Iliamna Lake tributaries downstream to the upper extent of tidal influence in the Kvichak River, with special emphasis on the Lower Talarik Creek and the UT.

^b Transportation Corridor surveys were conducted at all potential stream crossing sites from NK east to Iniskin Bay.



Objective 1

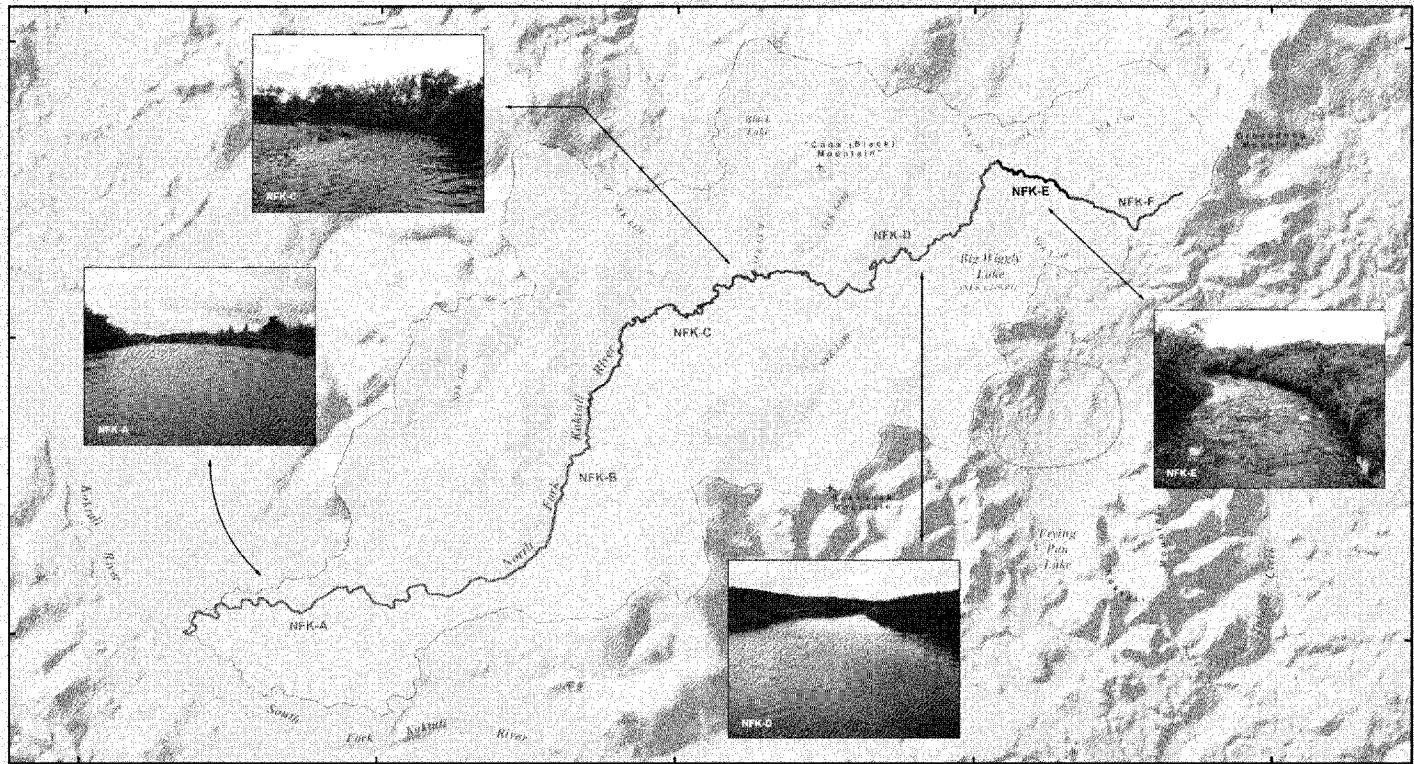
Document stream channel & valley form characteristics



- Largely single-thread, gravel-bedded, low gradient channels
- Influenced by glaciation: old lake deposits & glacial outwash
- High flows typically overtop stream banks
- Riparian, wetlands, & off-channel habitats extend into the valley



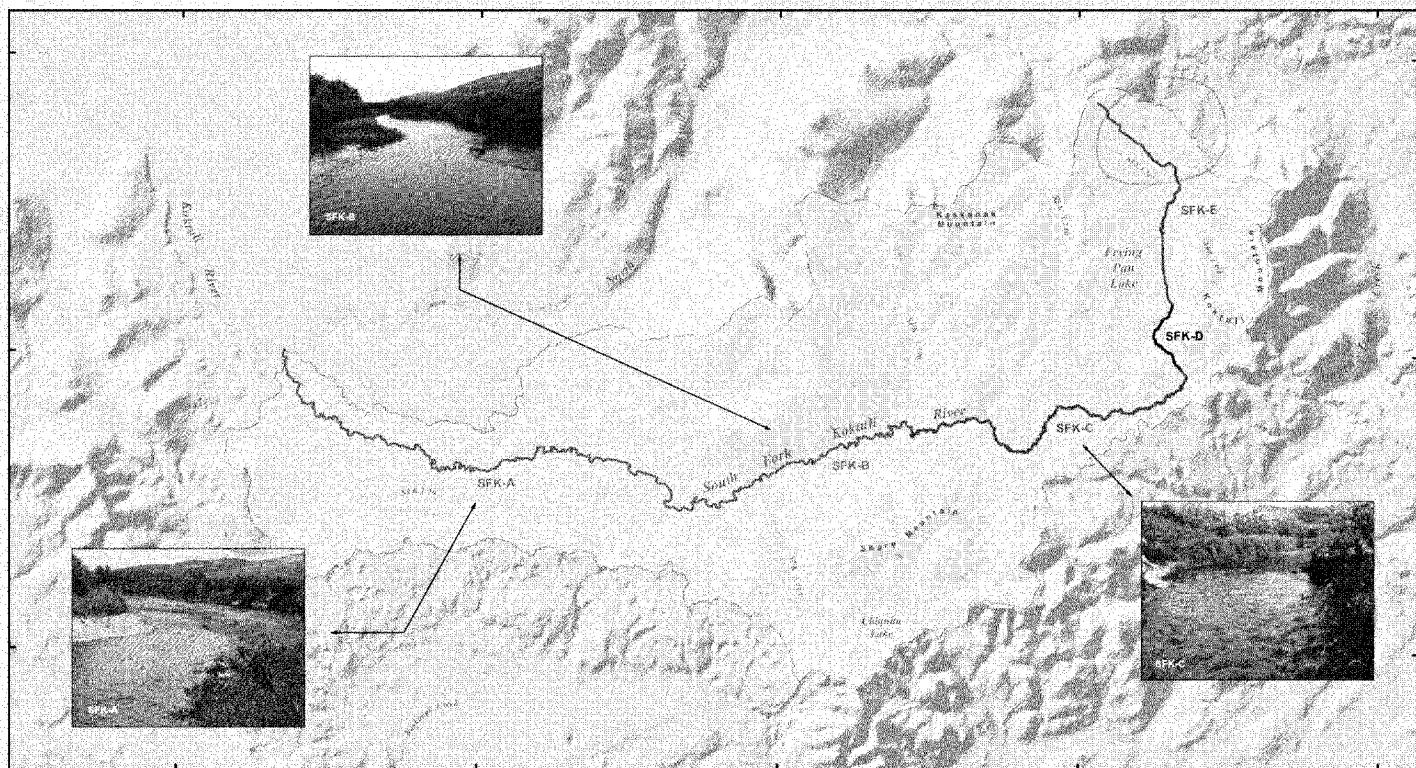
North Fork Koktuli River



EPA-7609-0005231-0039



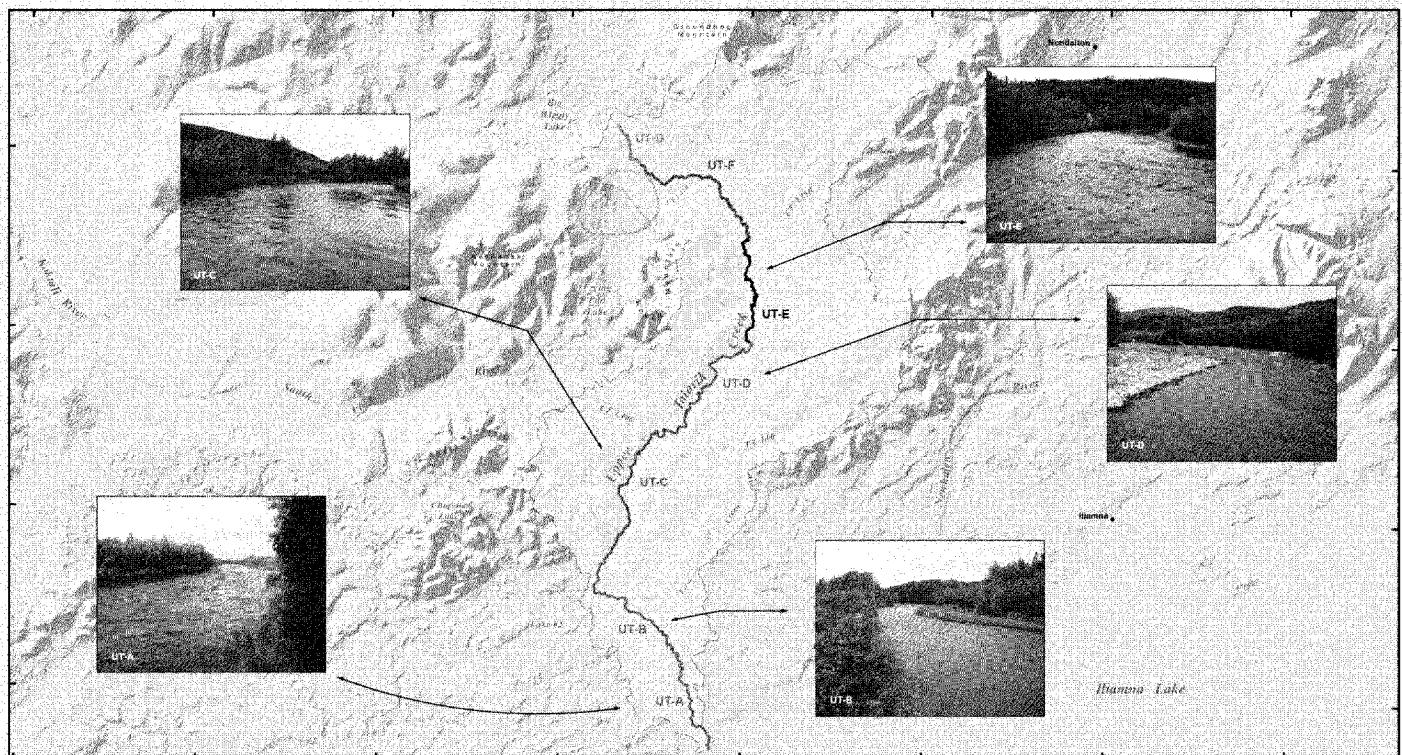
South Fork Koktuli River



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Upper Talarik Creek

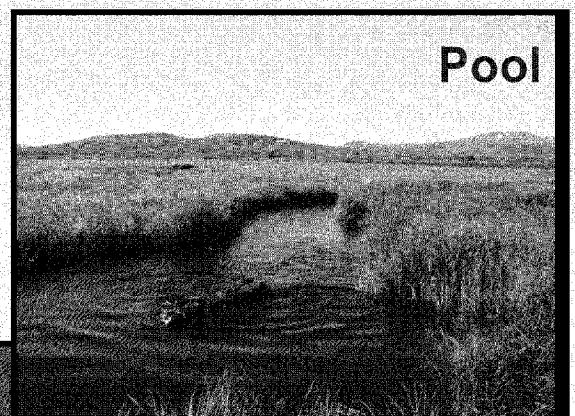
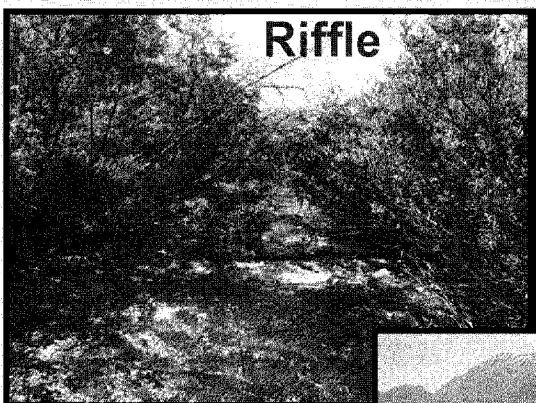


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Objective 2

Characterize riverine habitat types & document distribution





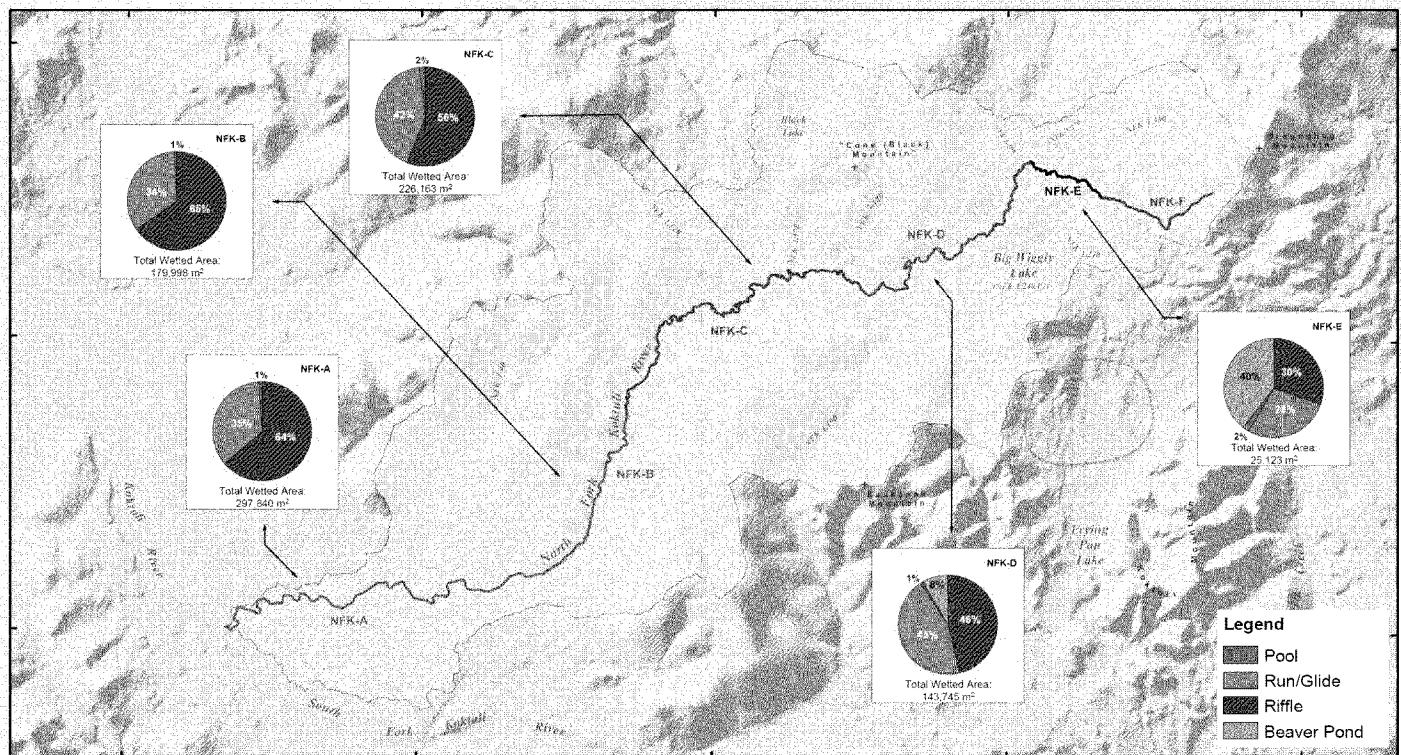
Mainstem & Tributary Habitat

Surveys

- Conducted using standard USFS habitat survey protocols
- Smaller mainstem reaches and tributaries
 - Continuous stream surveys conducted on foot
- Larger water, such as the lower UT, boats were used

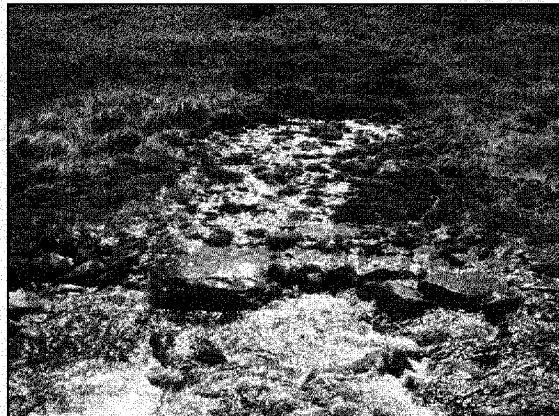


Example Mainstem Habitat Types - NFK



Objective 3

Document locations of special habitat features



- Seeps & springs
- Beaver ponds & dams
- Intermittent flow reaches
- Lakes & ponds
- Tributaries





Special Habitat Features

NFK

- Groundwater upwelling in lower reaches
- Intermittent flow in some tributaries
- Beaver ponds were limited in mainstem to upper reaches, yet abundant in off-channel areas
- Big Wiggly Lake supports specific life history of sockeye salmon



Special Habitat Features

SFK

- Intermittent flow in some years upstream from one of the upper tributaries
- Groundwater upwelling in mainstem below one of the tributaries & in tributaries upstream of Frying Pan Lake
- Beaver ponds concentrated upstream of Frying Pan Lake & in off-channel areas
- Lakes & ponds are common high in the watershed
- Two large lakes - Frying Pan & Chiquita Lakes





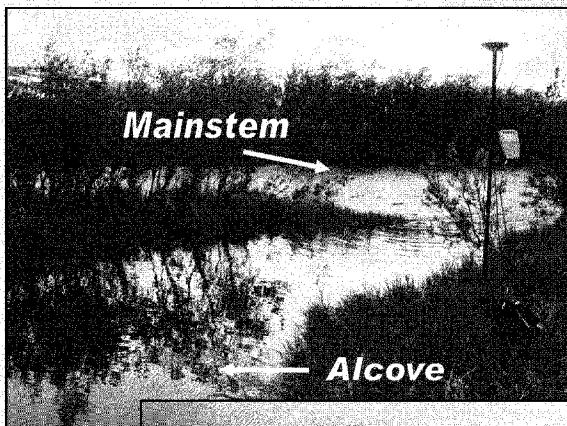
Special Habitat Features

UT

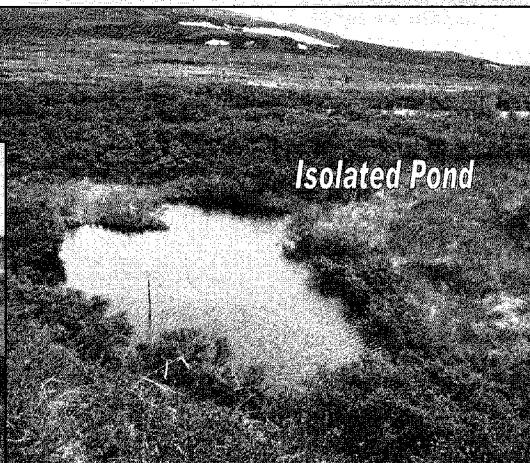
- Groundwater influence throughout
- Constant cross-basin flow from SFK
- Beaver ponds scarce in the mainstem, yet abundant in off-channel areas
- Lakes & ponds are prevalent throughout, particularly on the eastern watershed boundary
- Lakes & ponds in some upper tributaries support spawning salmon

Objective 4

Describe quantity & types of off-channel habitats

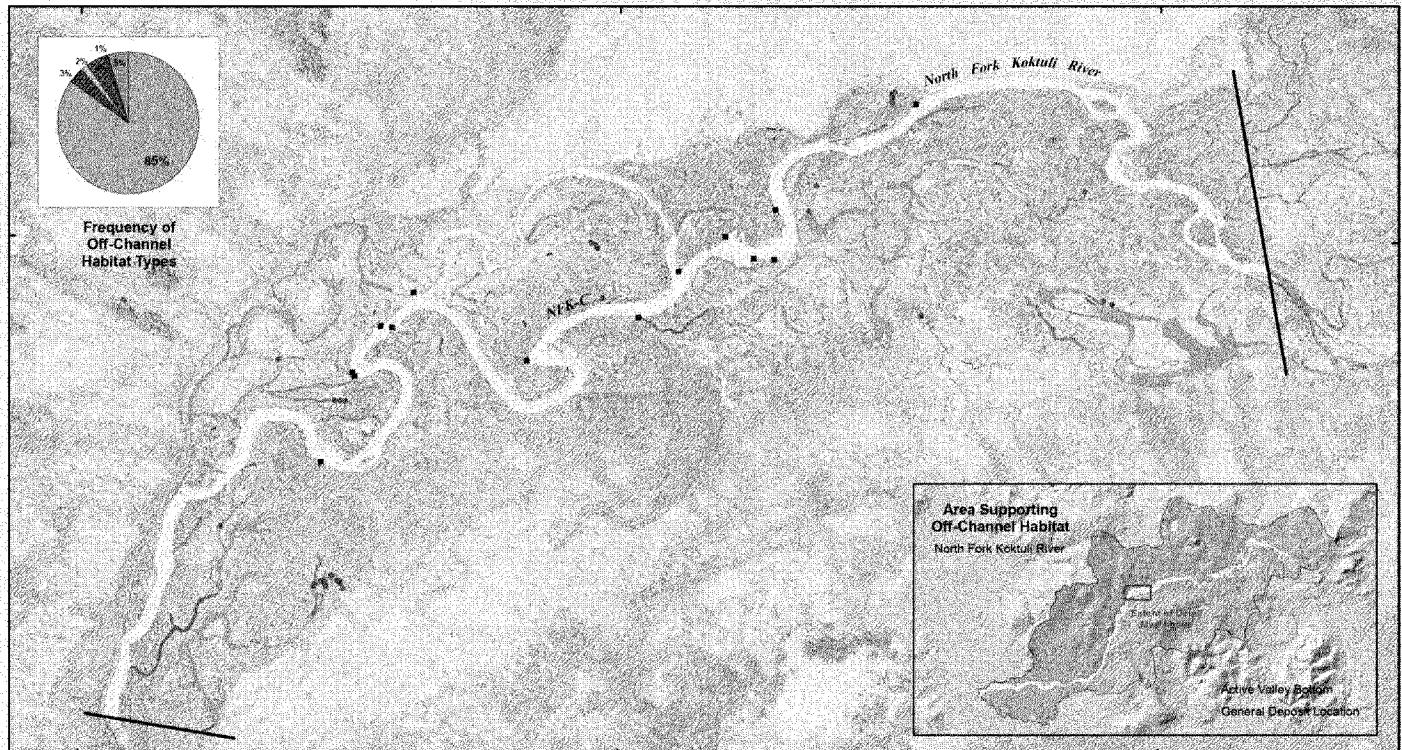


- Beaver ponds & outlet channels, alcoves, isolated ponds, side channels, & percolation channels





Distribution & Frequency: Off-channel Habitat Types in NFK



Legend

- Beaver Pond
- Beaver Pond Outlet Channel
- Alcove

- Isolated Pond
- Side Channel
- Percolation Channel

Study Area Extents

- Inlets

- Fish Sampling Sites

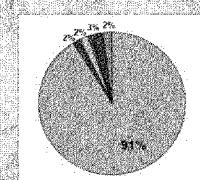
Mainstem

Active Valley Bottom

EPA-7609-0005231-0050



Distribution & Frequency: Off-channel Habitat Types in SFK



Frequency of Off-Channel Habitat Types

South Fork Koktuli River

SPK R

Area Supporting
Off-Channel Habitat

South Fork Koktuli River

Active Valley Bottom
General Deposit Location

Legend

- Beaver Pond
- Beaver Pond Outlet Channel
- Alcove

- Isolated Pond
- Side Channel
- Percolation Channel

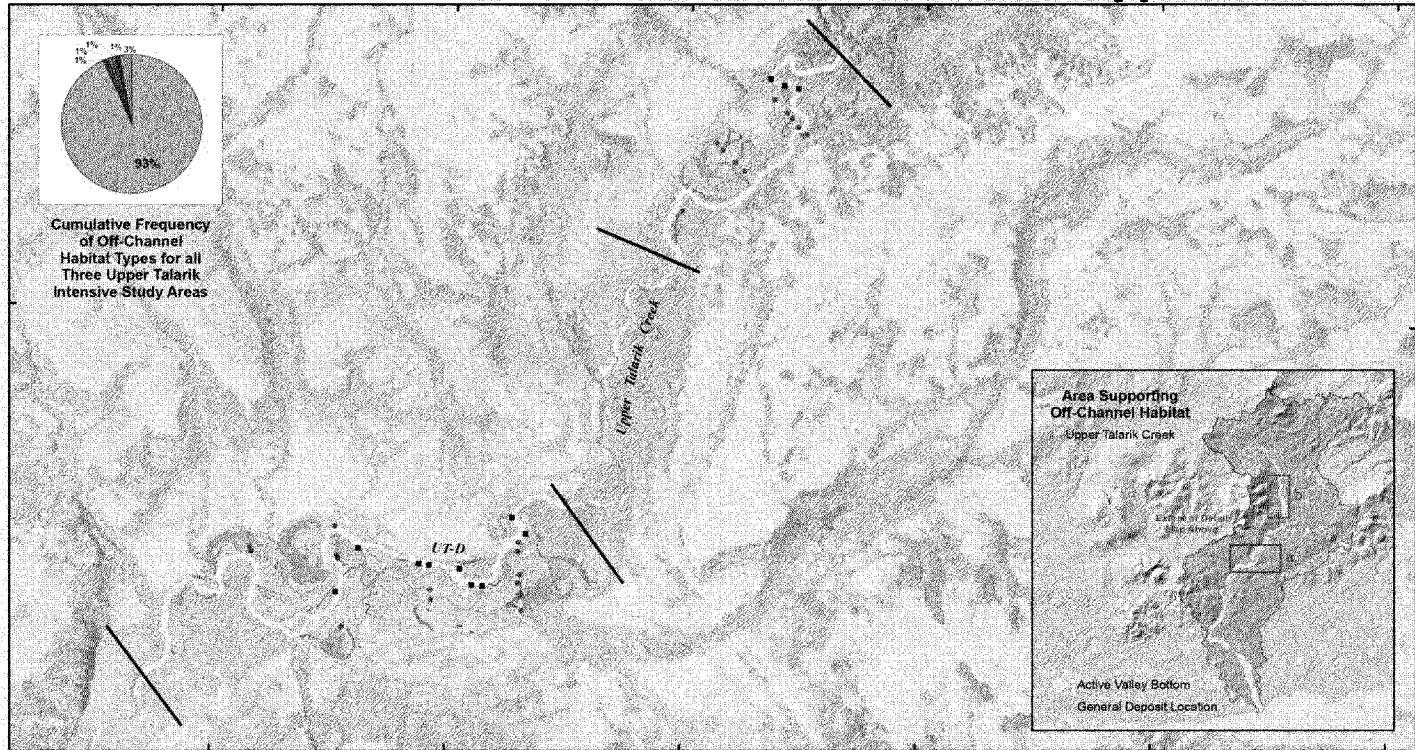
Study Area Extents

- Inlets
- Fish Sampling Sites
- Mainstem
- Active Valley Bottom

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Distribution & Frequency: Off-channel Habitat Types in UT



Legend

- Beaver Pond
- Beaver Pond Outlet Channel
- Alcove

- Isolated Pond
- Side Channel
- Percolation Channel

Study Area Extents

- Inlets
- Fish Sampling Sites

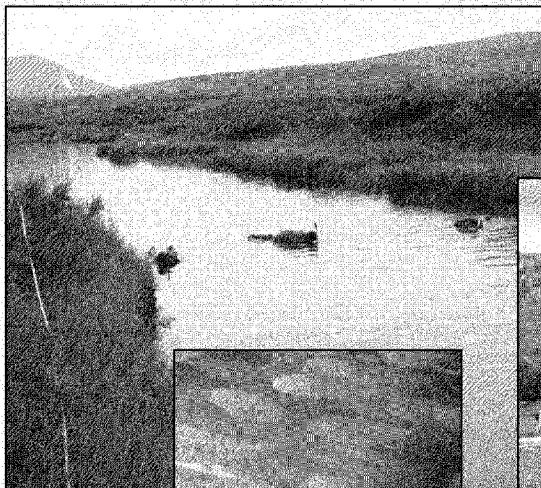
- Mainstem
- Active Valley Bottom

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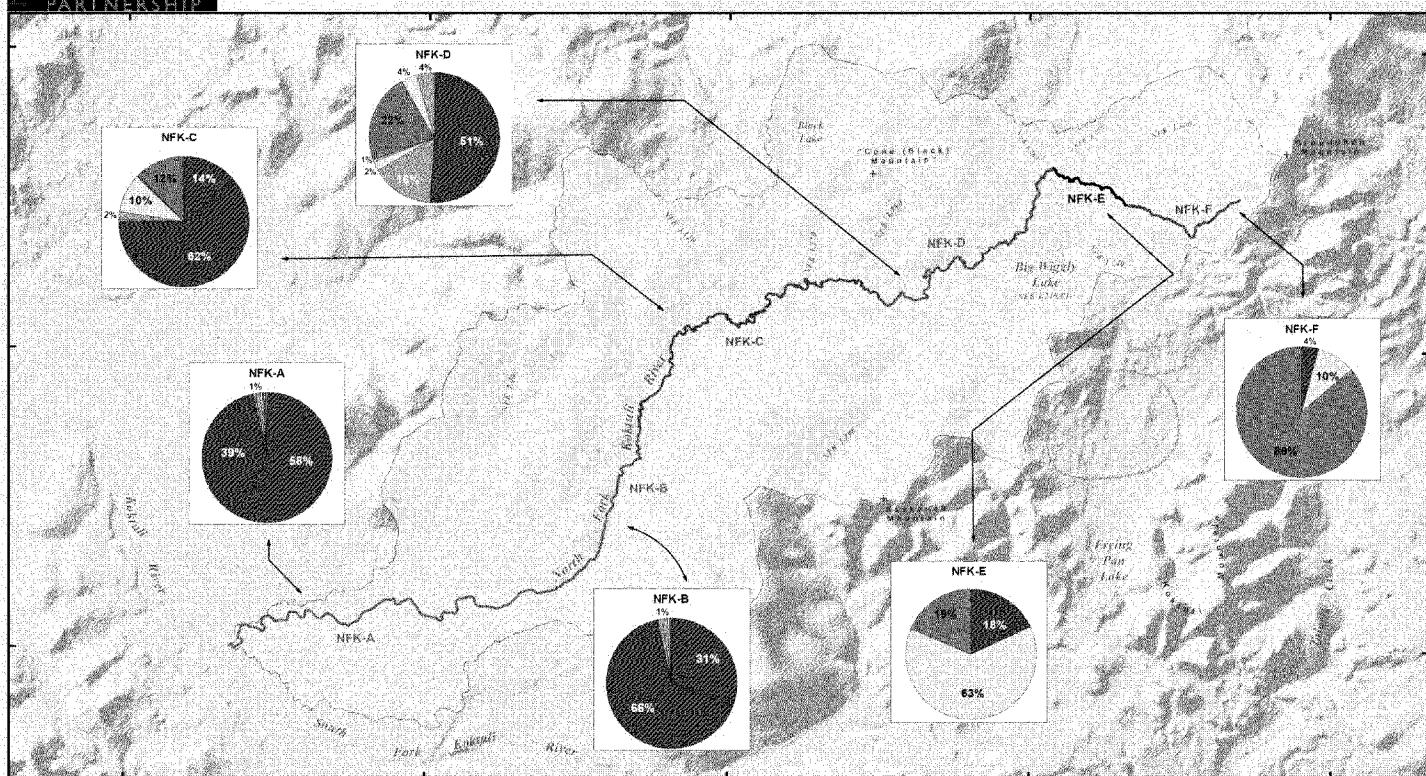
Objective 5

Describe patterns of fish distribution & abundance in mainstem, tributary, & off-channel habitats

- 3,000 sampling locations (NFK, SFK, UT, & KR)
- Snorkeling , electrofishing, minnow trapping, seining, tangle netting, angling, and dipnetting



Fish Species Composition in NFK



Legend

Chinook Salmon	Arctic Grayling	Sculpin
Chum Salmon	Dolly Varden	Stickleback
Coho Salmon	Rainbow Trout	Northern Pike
Sockeye Salmon	Whitefish	Other Species



Common Name	SFK-A	SFK-B	SFK-C	SFK-D	SFK-E
Chinook salmon	X	X	X	X	
Chum salmon	X	X	X		
coho salmon	X	X	X	X	X
sockeye salmon	X	X	X		X
Arctic grayling	X	X	X	X	X
Dolly Varden	X	X	X	X	X
rainbow trout	X	X			X
whitefish	X	X	X		
sculpin	X	X	X	X	X
northern pike		X	X	X	X
ninespine stickleback	X	X	X		X
threespine stickleback	X	X			X
burbot		X	X		
lamprey	X	X			

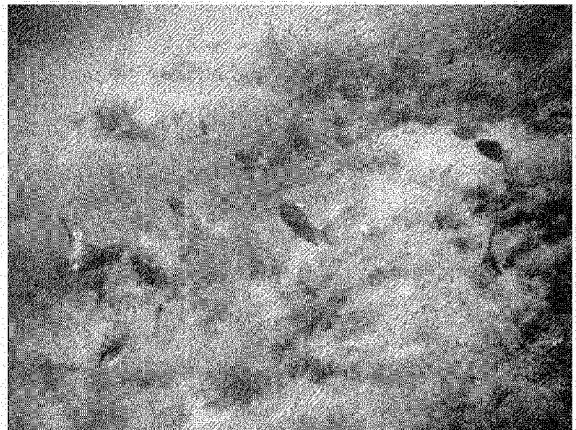
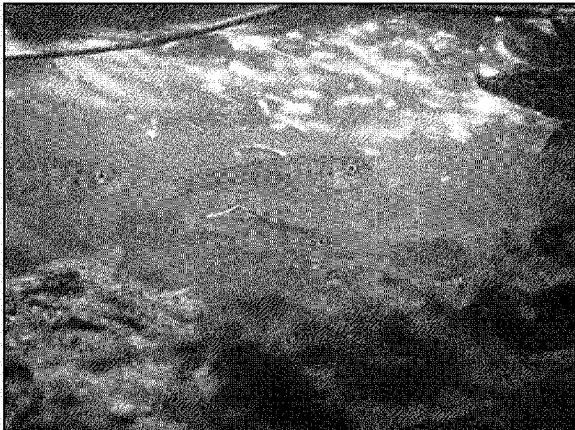
- 13 species
- Greatest number SFK-B
- Anadromous vs. resident dominances changes at Frying Pan Lake (ds end SFK-E)
- Coho salmon, arctic grayling, Dolly Varden, & sculpin throughout



Objective 6

Compare fish densities among habitat types

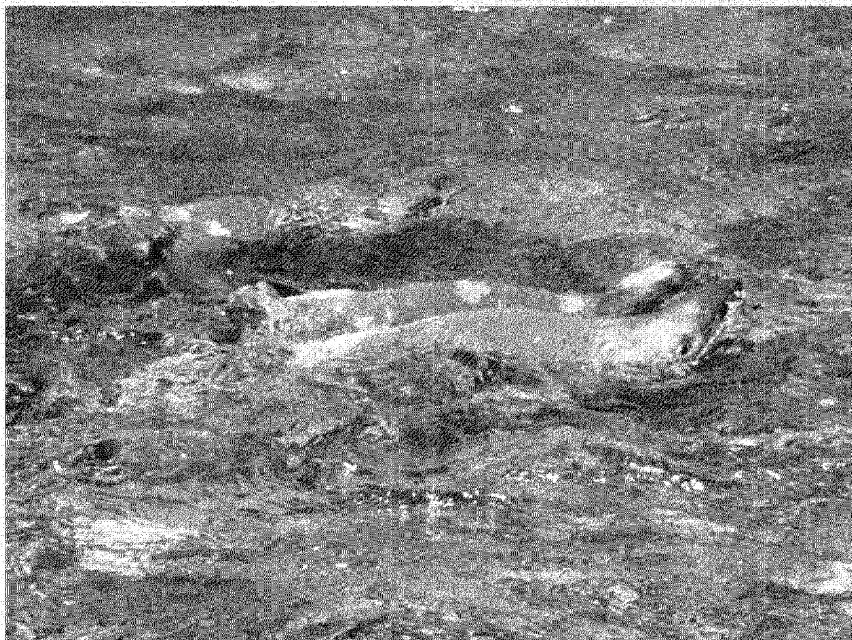
- Number of fish per 100 m²
 - (total number of fish/total area surveyed for each species & habitat type)
- Snorkeling & electrofishing
- Representative of freshwater rearing stages



Objective 7



Describe the distribution and abundance of spawning anadromous salmon

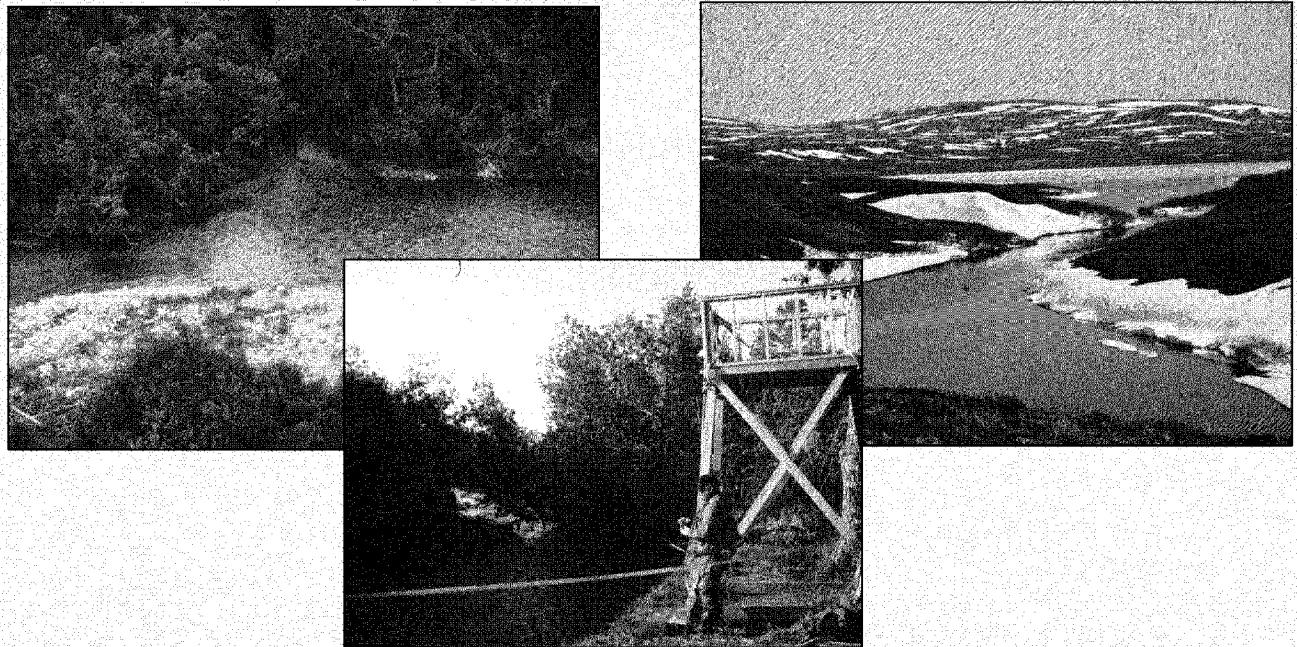


- Chinook
- Coho
- Sockeye
- Chum

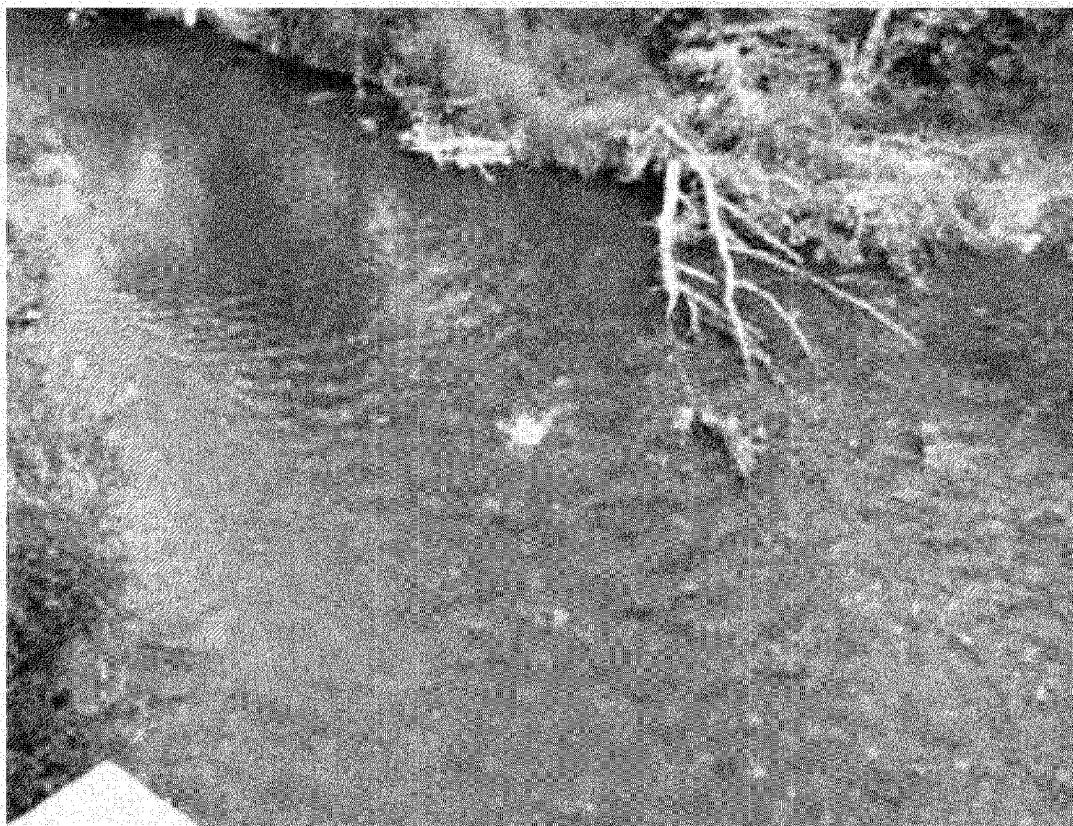


Aerial Surveys

- July – October (November in 2008)
- Surveys repeated throughout spawning season
- Tower counts added in 2009 – Otter Creek & UT mainstem upstream of Otter Creek



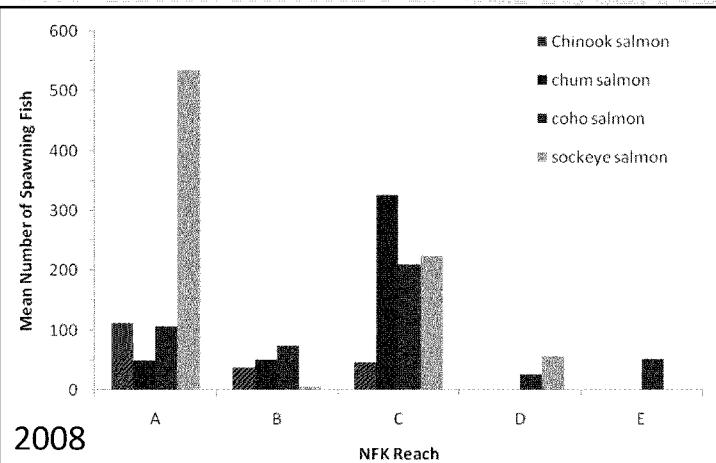
EPA-7609-0005231-0058



EPA-7609-0005231-0059



NFK Spawning Distribution

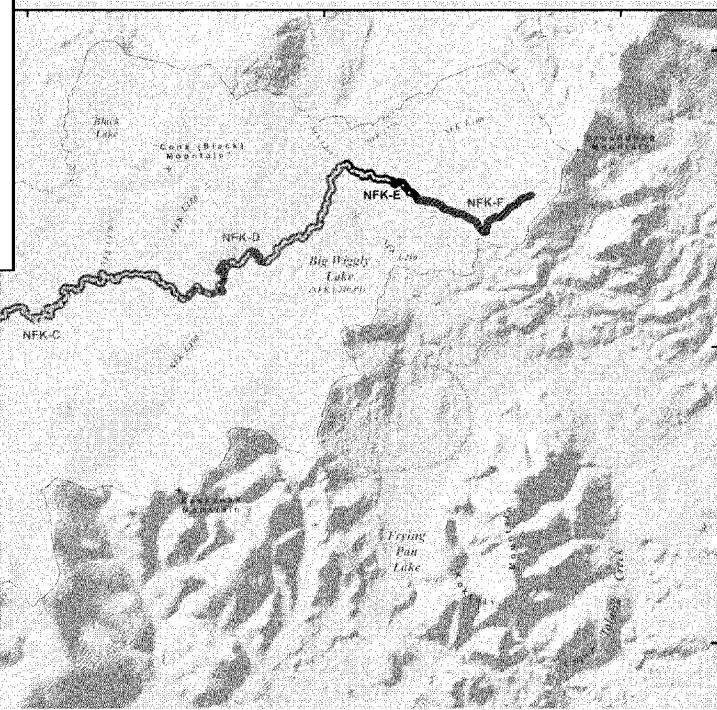


2008

NFK Reach

- Chinook salmon
- chum salmon
- coho salmon
- sockeye salmon

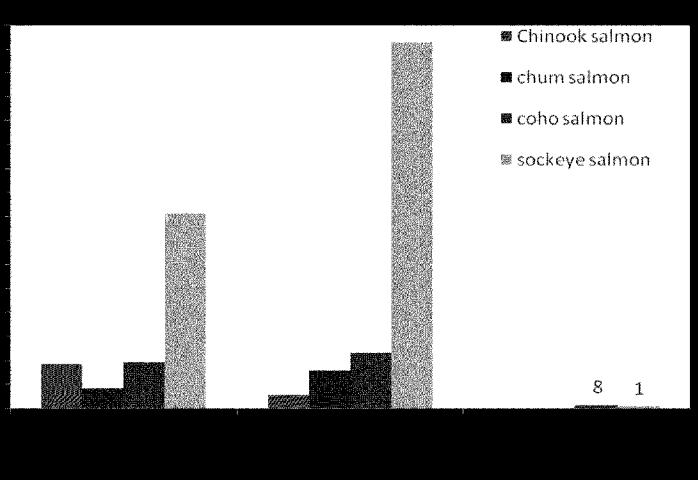
2004-2008



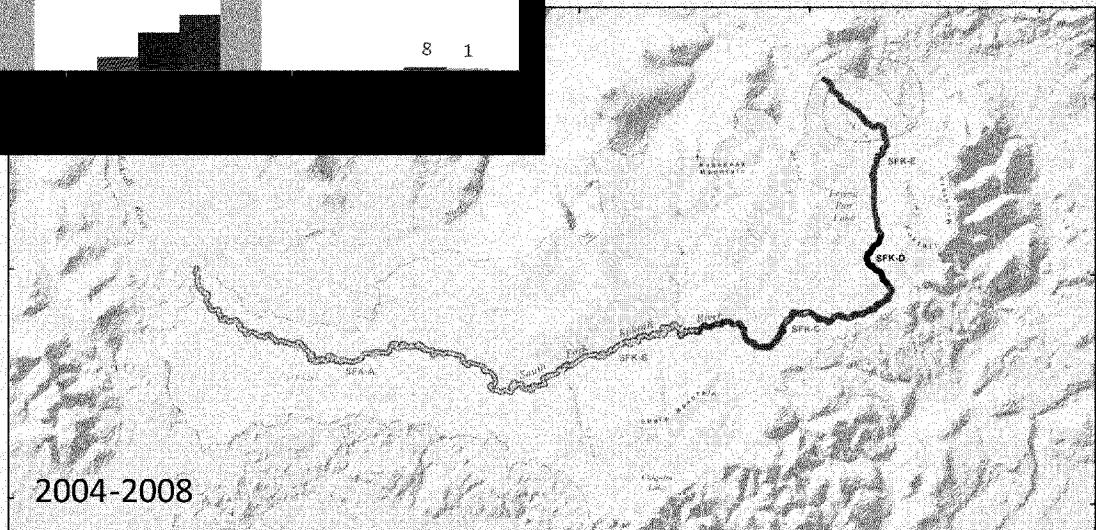
EPA-7609-0005231-0060



SFK Spawning Distribution



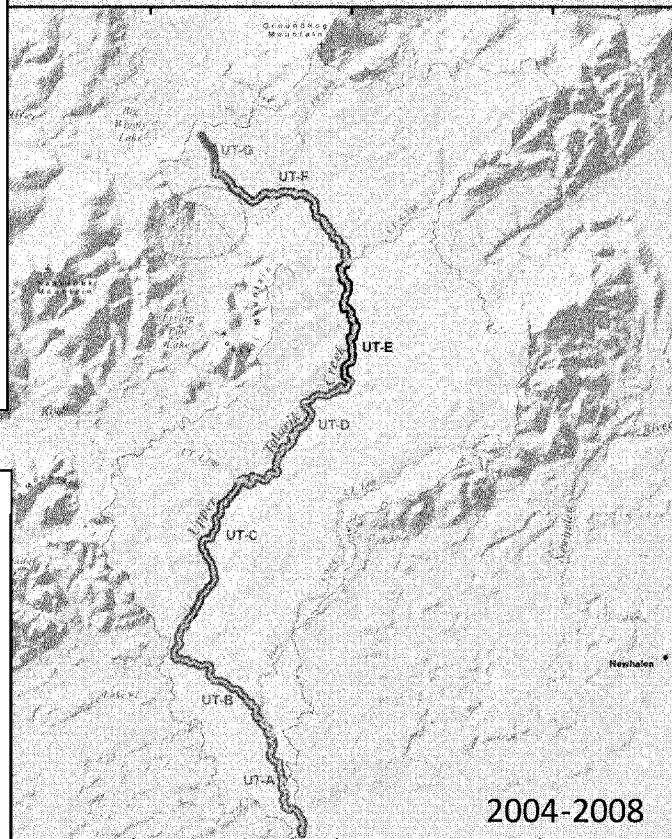
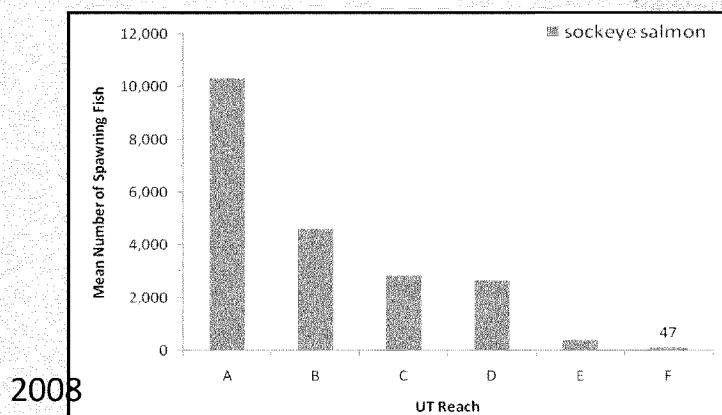
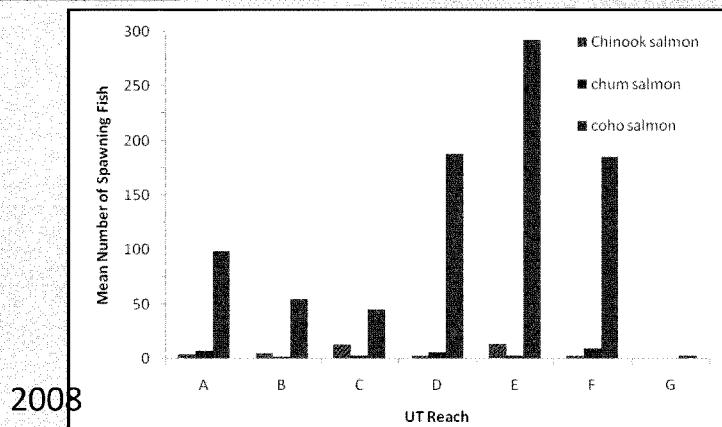
2004-2008



EPA-7609-0005231-0061



UT Spawning Distribution

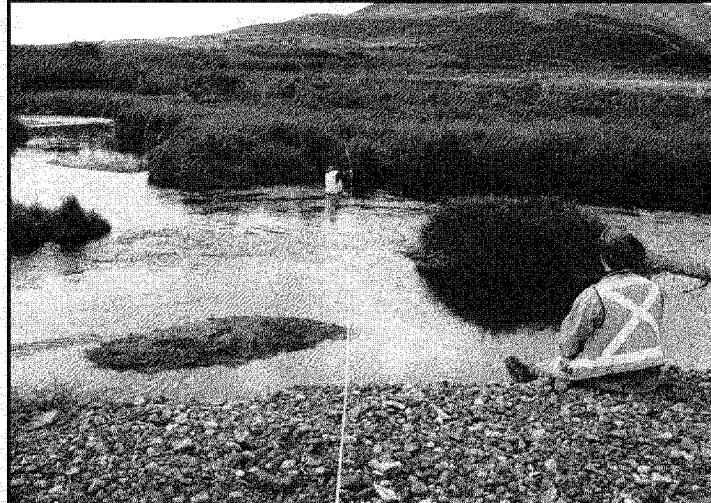
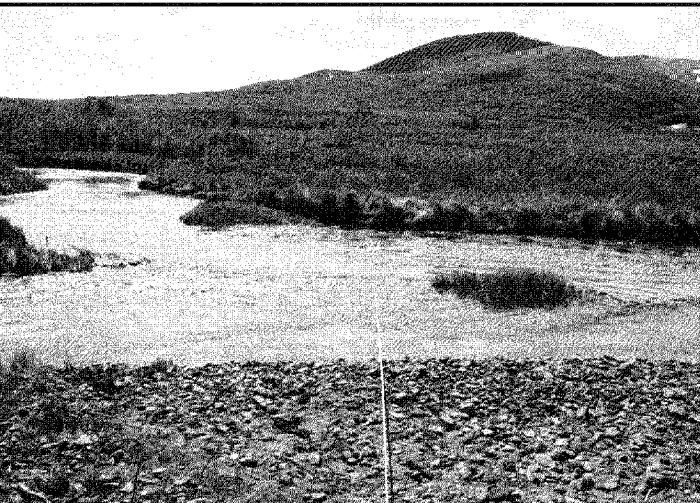


EPA-7609-0005231-0062



Flow-Habitat Studies

- Mainstem Channel Flow Habitat Studies
- Off-Channel Flow Habitat Studies
- Water Temperature Monitoring/Modeling
- Fluvial Geomorphology and Spawning Gravel Quality Studies



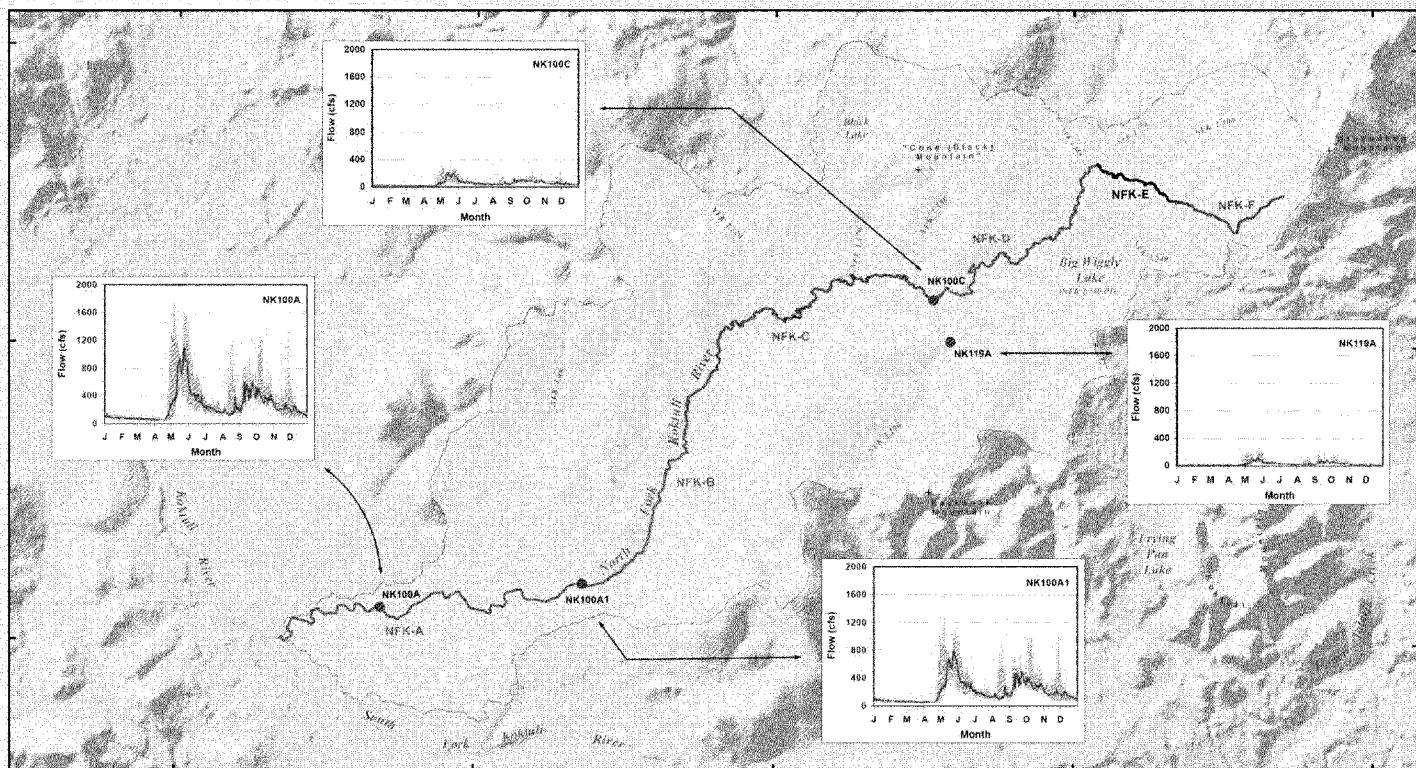
EPA-7609-0005231-0063



Instream Flow Study Components

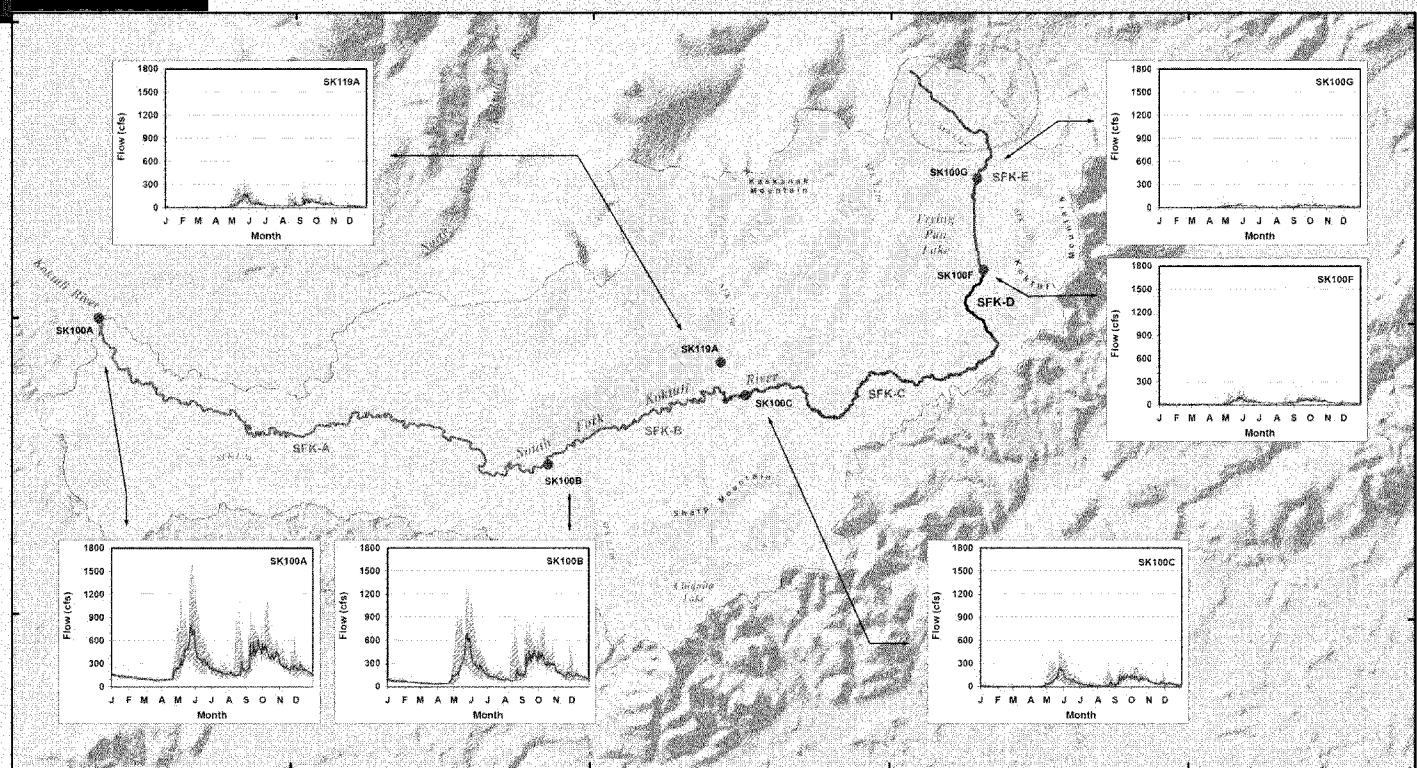
- Mainstem Study
 - 1 dimensional PHABSIM modelling
 - Habitat Suitability Curve (HSC) development
 - Develop flow-habitat time series
- Off-channel Habitat (OCH)
 - Classify OCH Types
 - Describe relationship between mainstem and OCH flow
 - Estimate connectivity

NFK Flow Selected River Gages 2005 - 2008



EPA-7609-0005231-0065

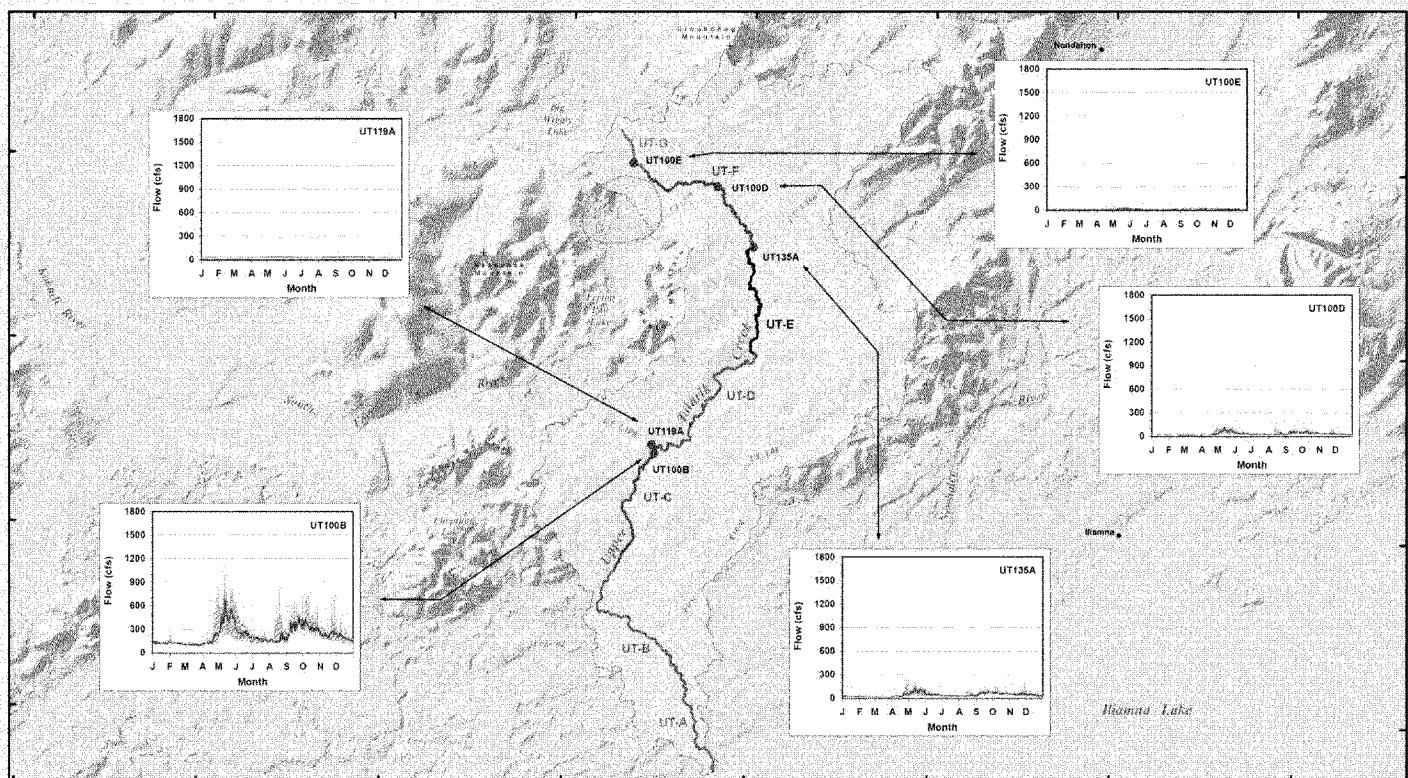
SFK Flow Selected River Gages 2005 - 2008



EPA-7609-0005231-0066



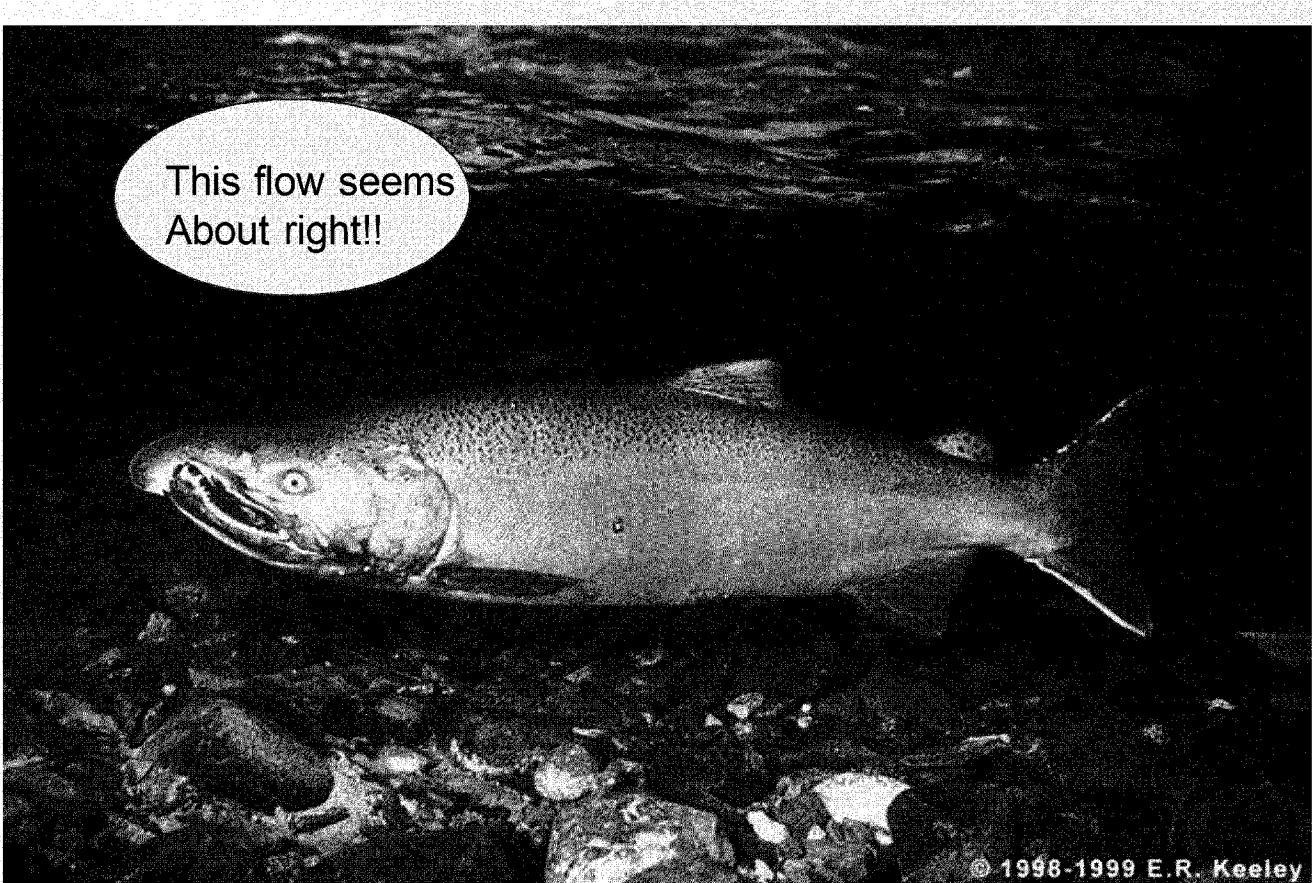
UT Flow Selected River Gages 2005 - 2008



EPA-7609-0005231-0067



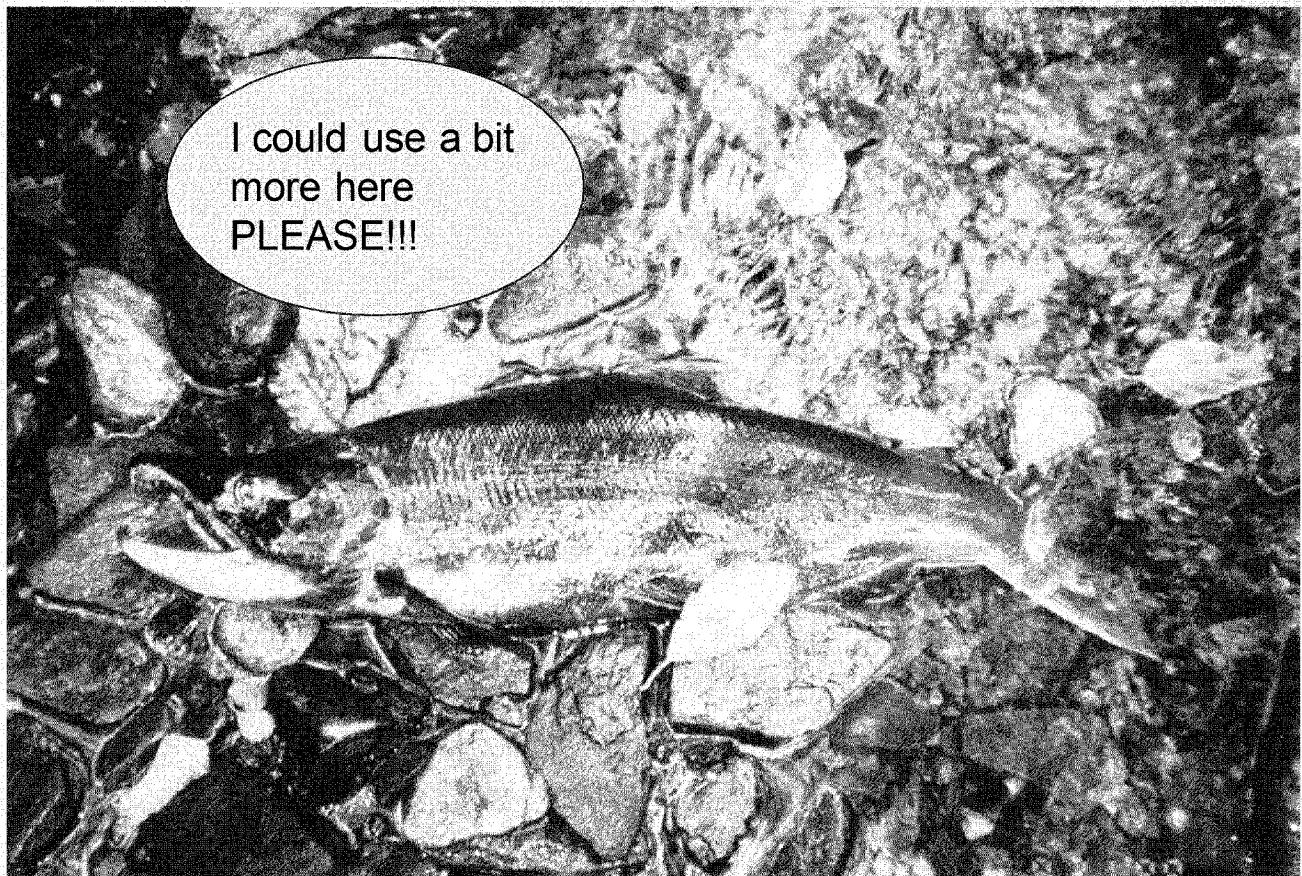
WHY WORRY ABOUT FLOW?



This flow seems
About right!!

© 1998-1999 E.R. Keeley

EPA-7609-0005231-0068



EPA-7609-0005231-0069



Instream Flow Habitat Modeling

Models include factors such as:

- Water surface elevations
- Water depth
- Discharge
- Velocity
- Substrate
- Channel geometry
- Cover
- Fish presence
- Habitat type:
 - Glide, run, riffle, pool, cascade, island complex





Spawning Gravel Characterization

- Pre-spawning Analysis
 - Six (6) Substrate samples collected from known spawning areas (54 samples total)
 - North Fork Koktuli – 3 sites x 6 samples
 - South Fork Koktuli – 3 sites x 6 samples
 - Upper Talarik Creek – 3 sites x 6 samples
- Post-spawning Analysis
 - Three (3) Substrate samples collected from each of the same sites (27 samples total)



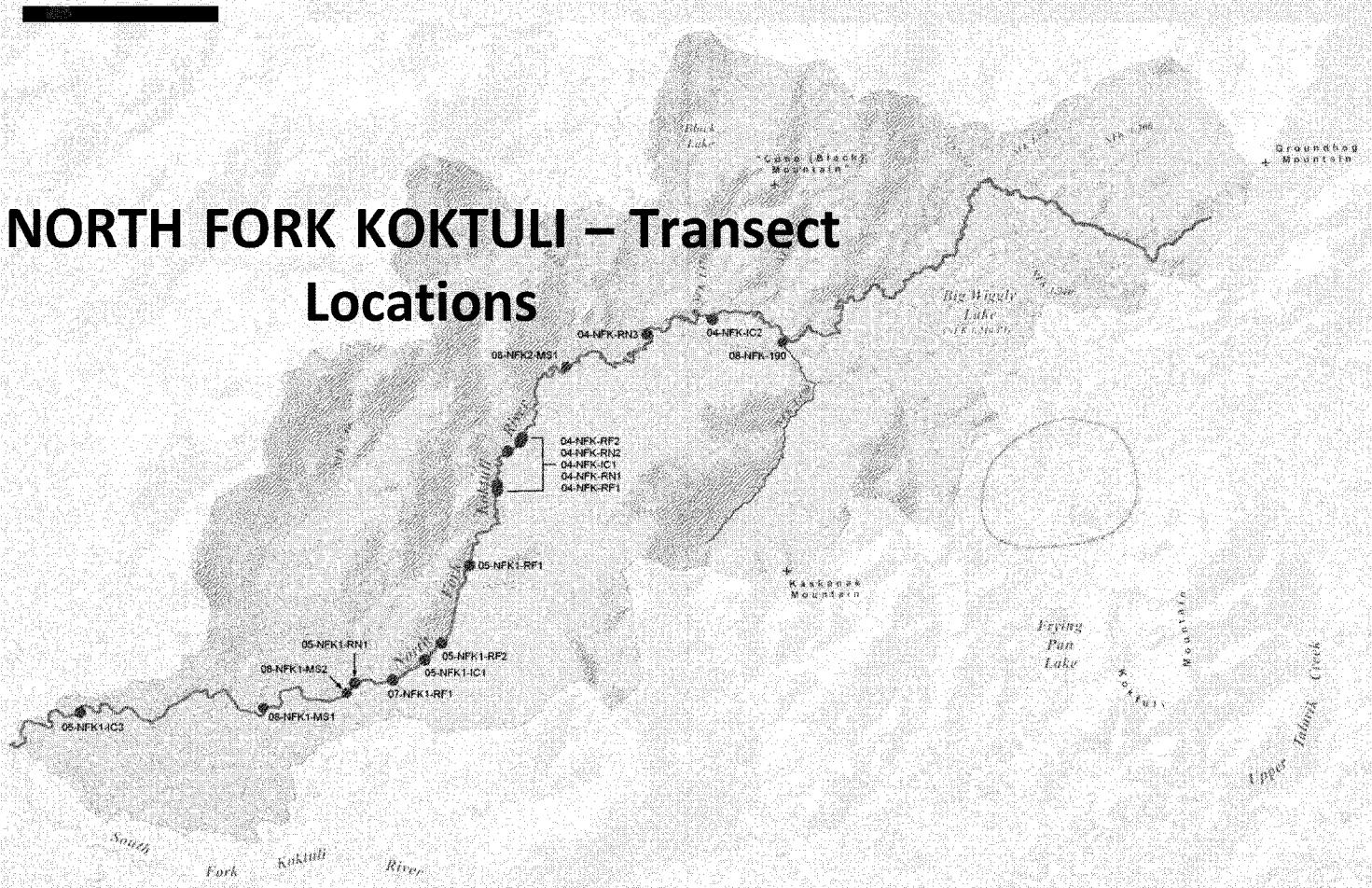


PHABSIM Sites Summary: Field Data Collection

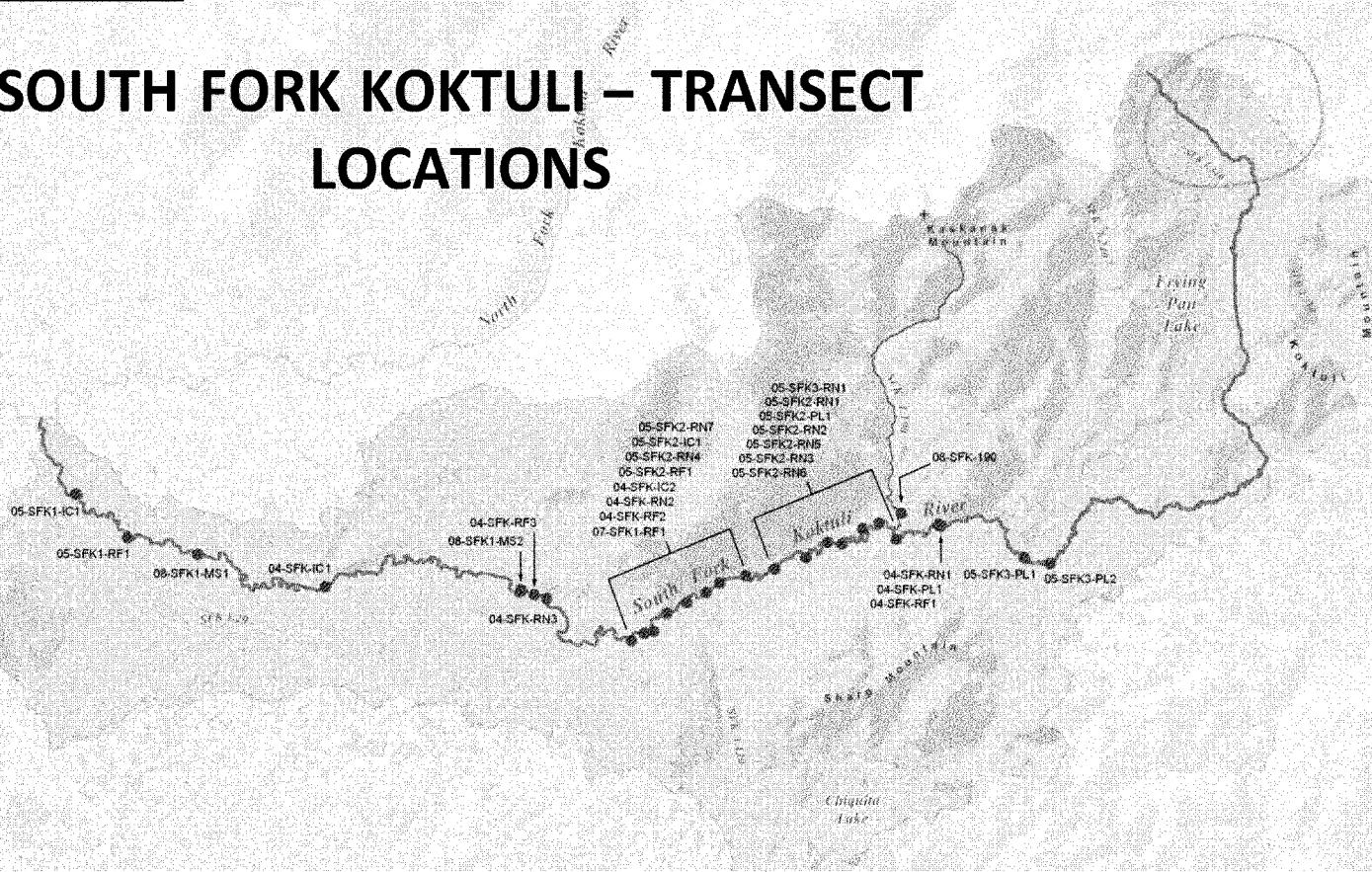
Total of 117 Transects used in Modeling

- North Fork Koktuli River Mainstem – 27 transects
- North Fork Koktuli River Tributary – 3 transects
- South Fork Koktuli River Mainstem – 37 transects
- South Fork Koktuli River Tributary – 6 transects
- Mainstem Koktuli River – 4 transects
- Upper Talarik Creek Mainstem – 35 transects
- Upper Talarik Creek Tributary – 5 transects

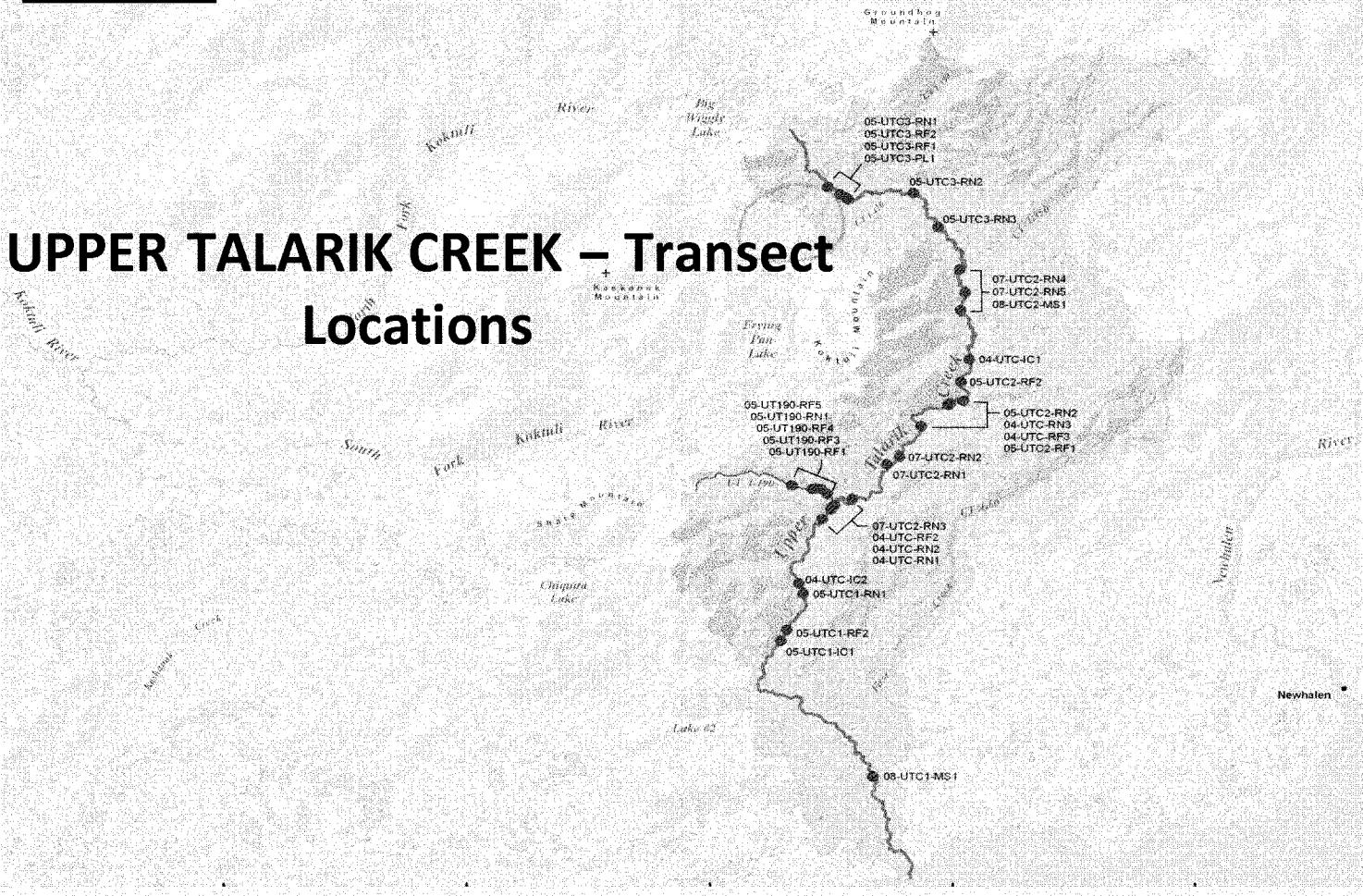
NORTH FORK KOKTULI – Transect Locations



SOUTH FORK KOKTULI – TRANSECT LOCATIONS



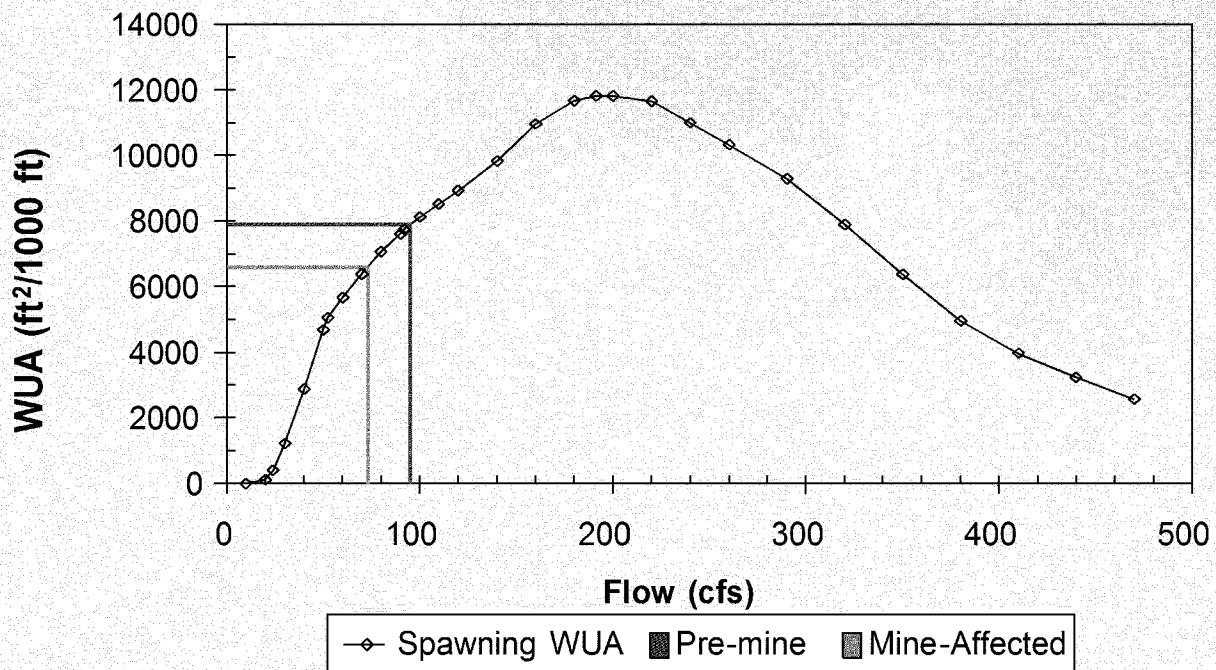
UPPER TALARIK CREEK – Transect Locations





05-SFK2-RN7

Average Year Chinook Spawning



Preliminary – Subject to Revision November 2010

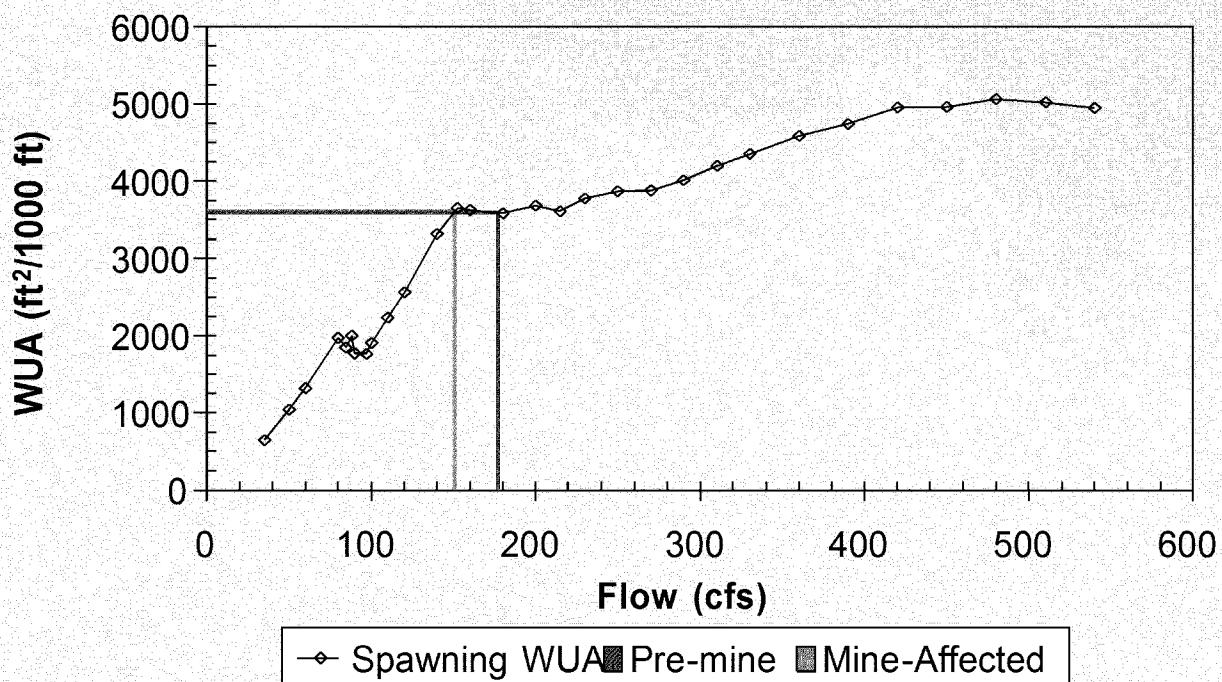
EPA-7609-0005231-0076



05-NFK1-RF1

Average Year

Coho Juvenile



Preliminary – Subject to Revision November 2010

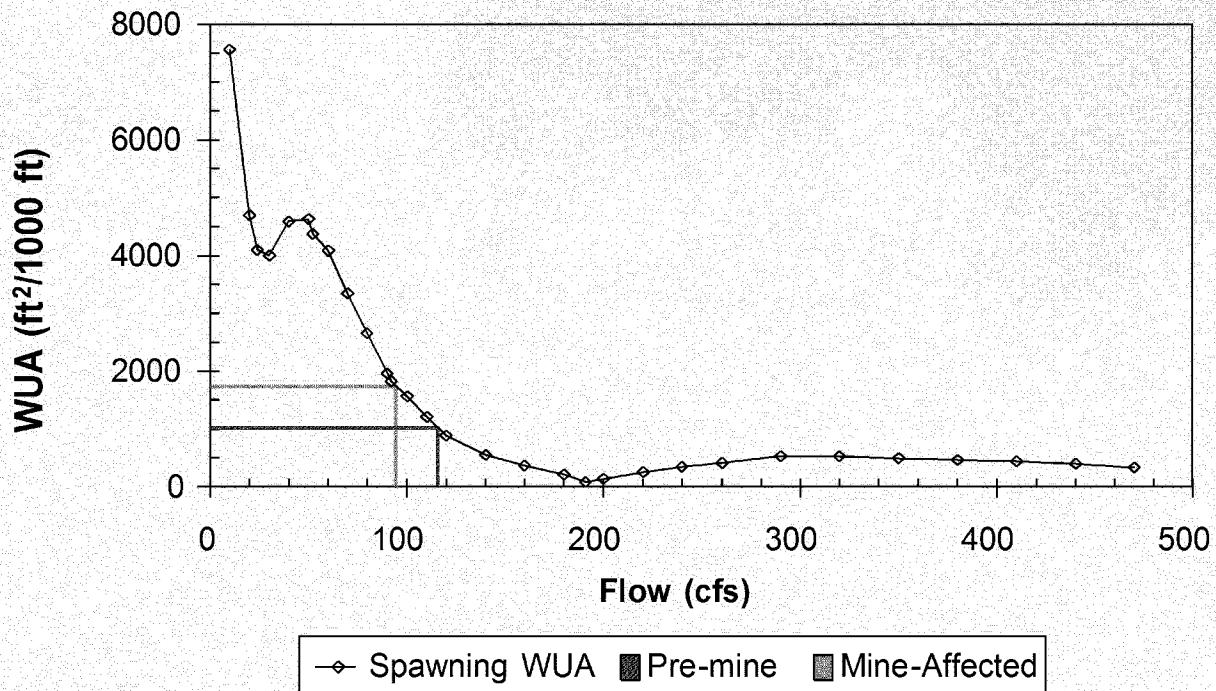
EPA-7609-0005231-0077



05-SFK2-RN7

Average Year

Coho Juvenile



Preliminary – Subject to Revision November 2010

EPA-7609-0005231-0078



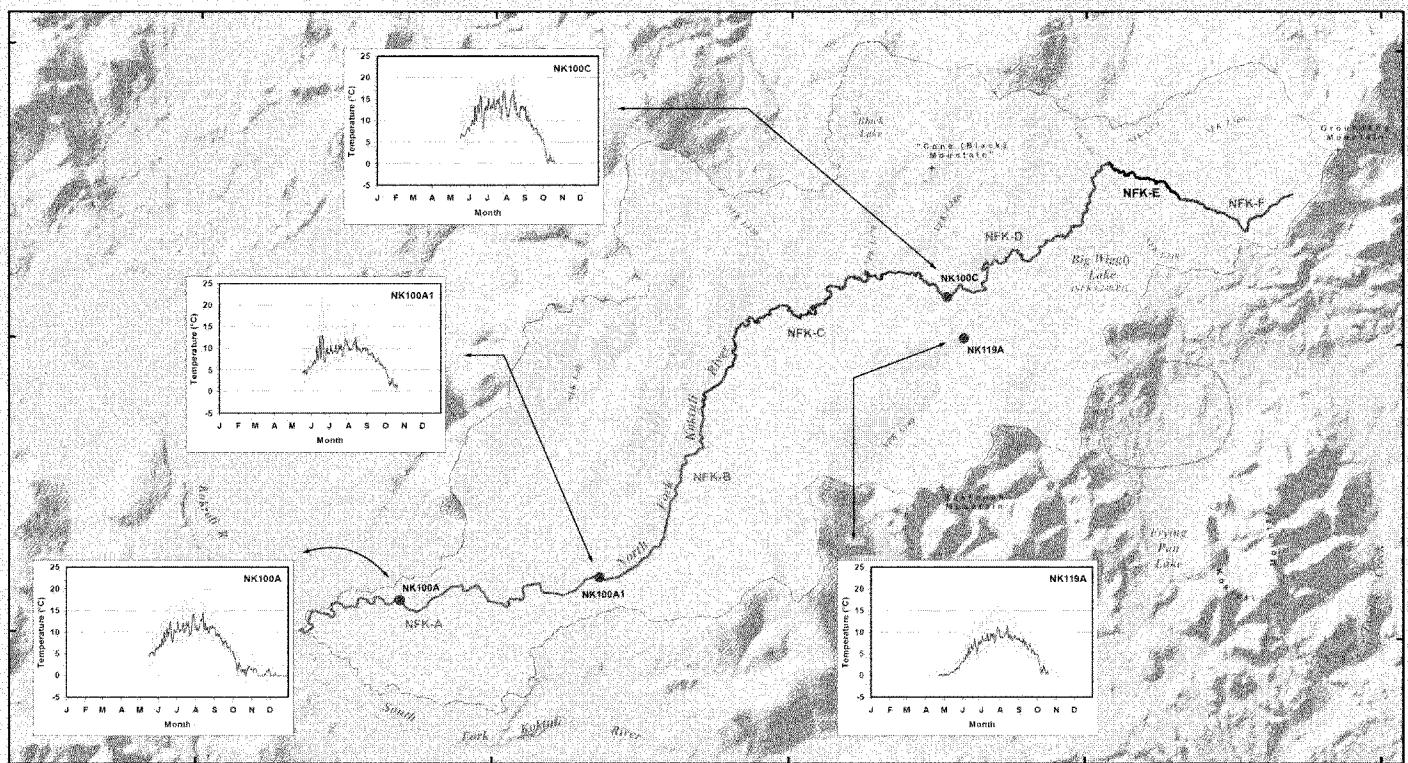
Water Temperature



EPA-7609-0005231-0079



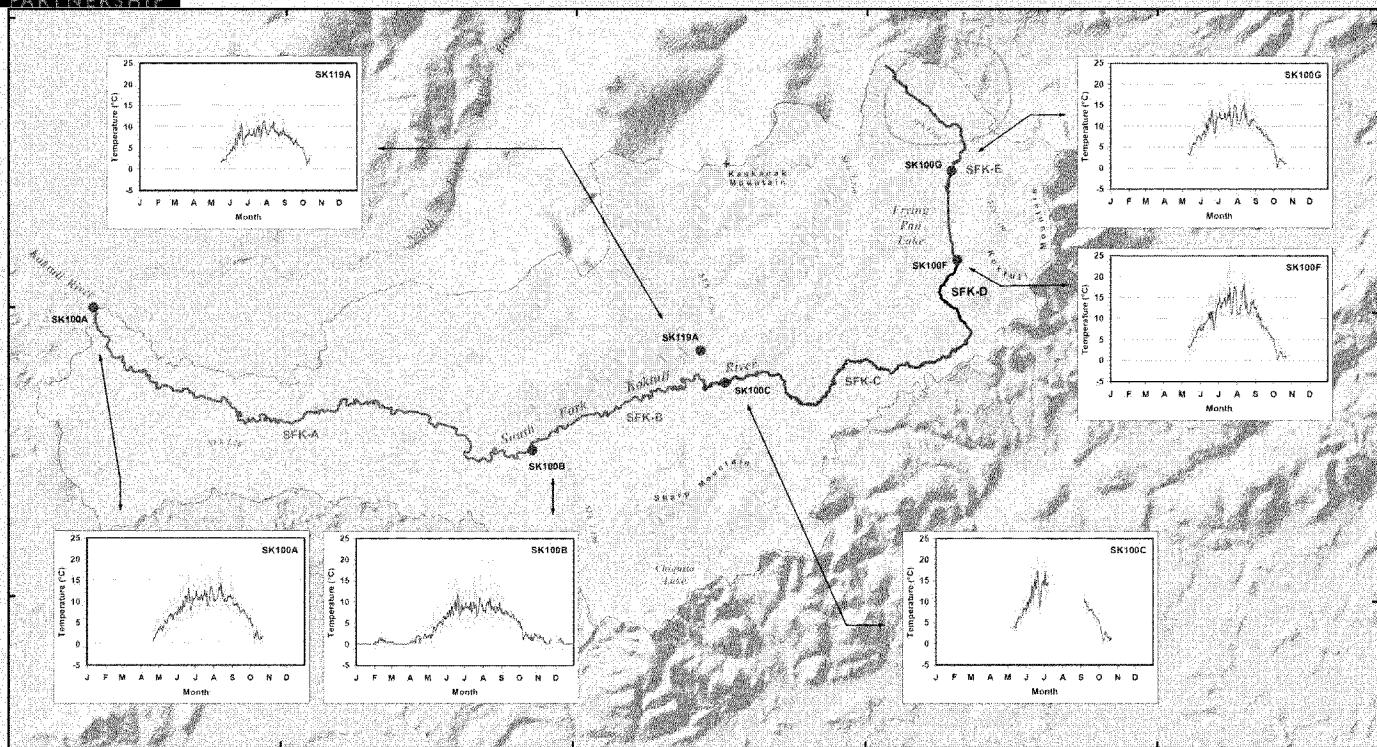
NFK Temperature at Selected Sites 2007



EPA-7609-0005231-0080

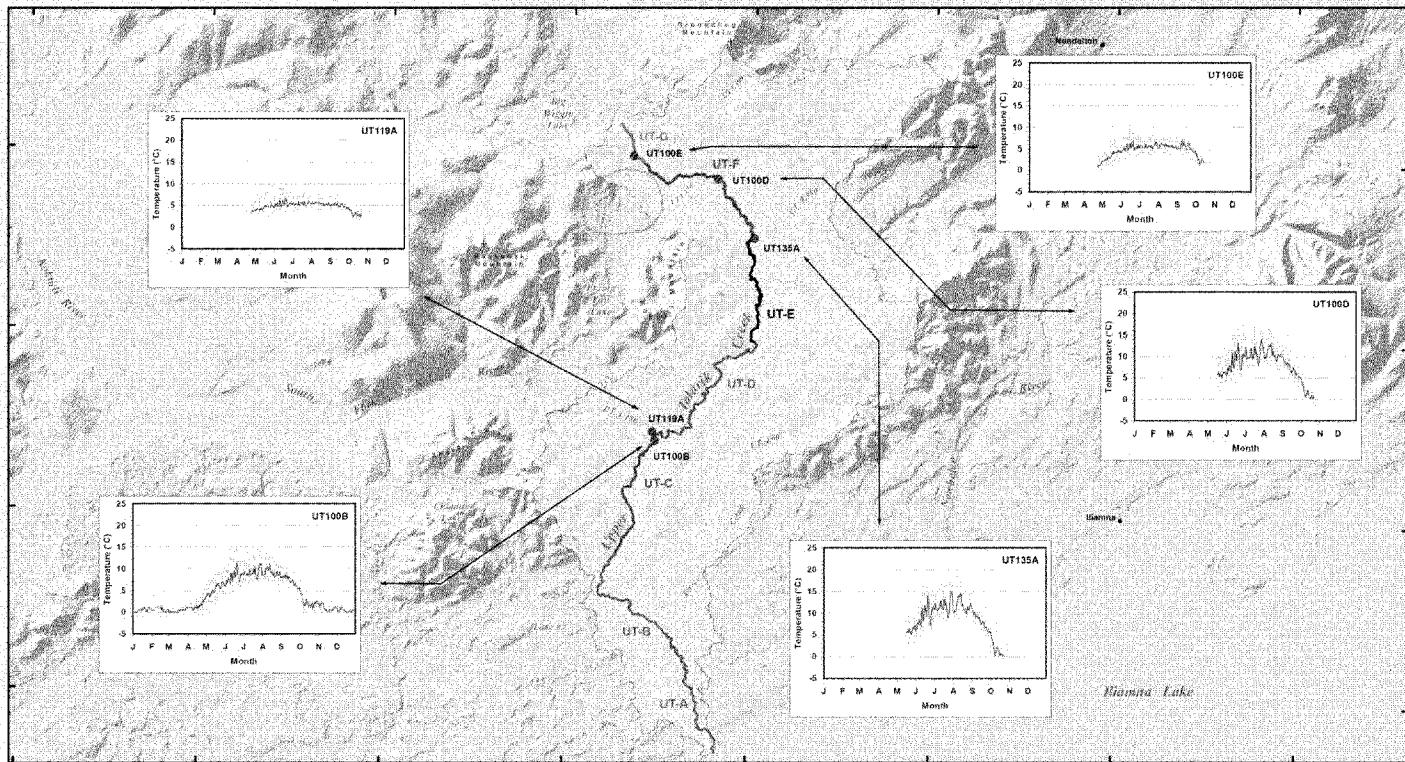


SFK Temperature at Selected Sites 2007



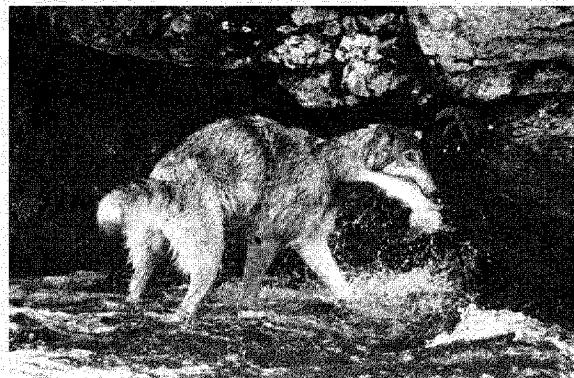
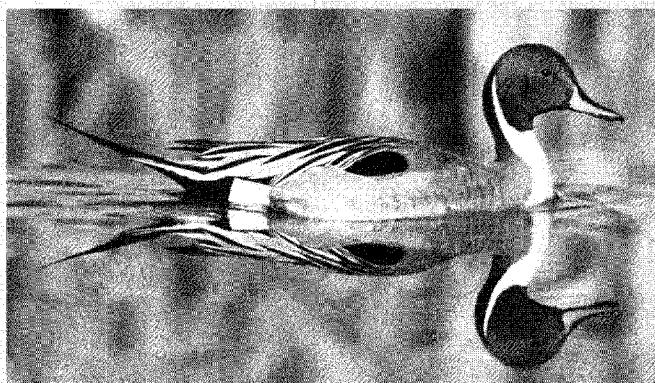
EPA-7609-0005231-0081

UT Temperature: Selected Sites 2007



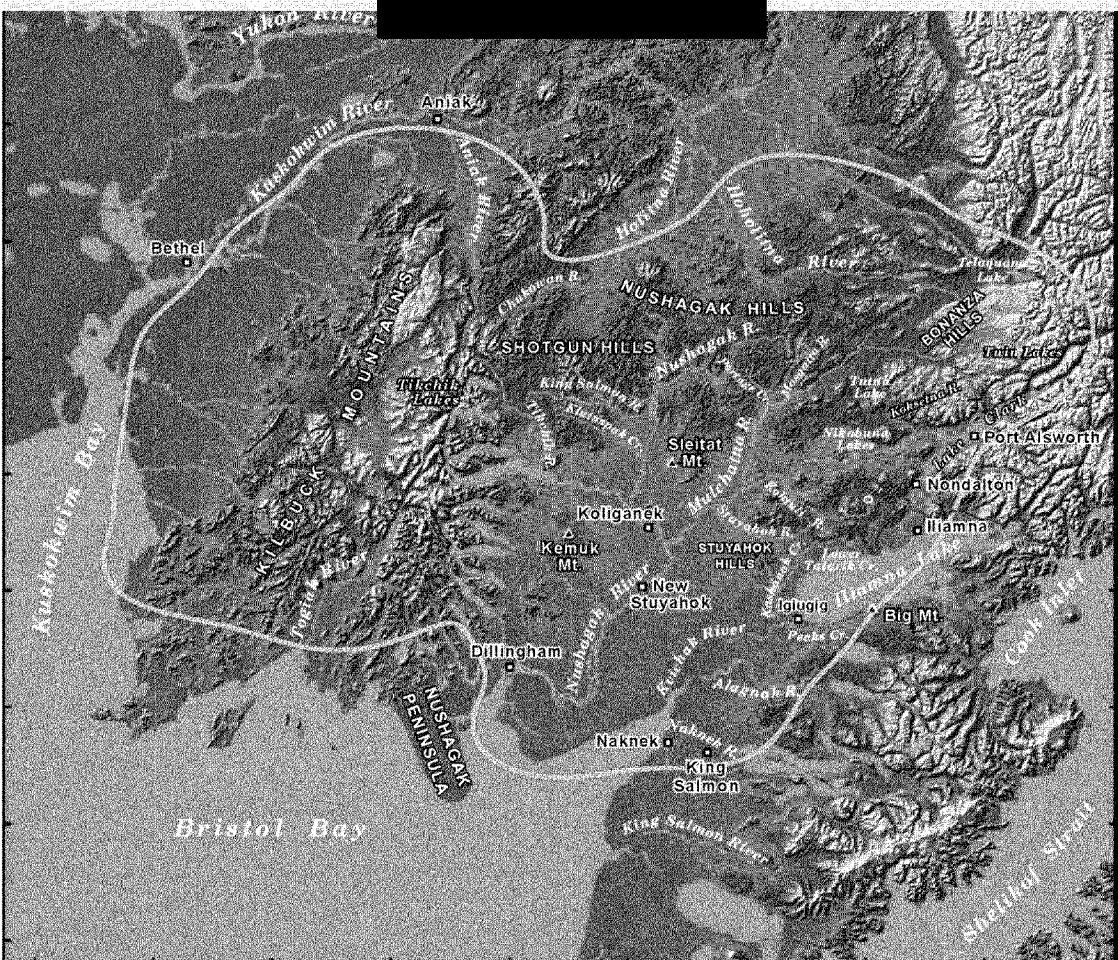


Wildlife Studies



EPA-7609-0005231-0083

Mulchatna Caribou Range, 1981–2010



EPA-7609-0005231-0084

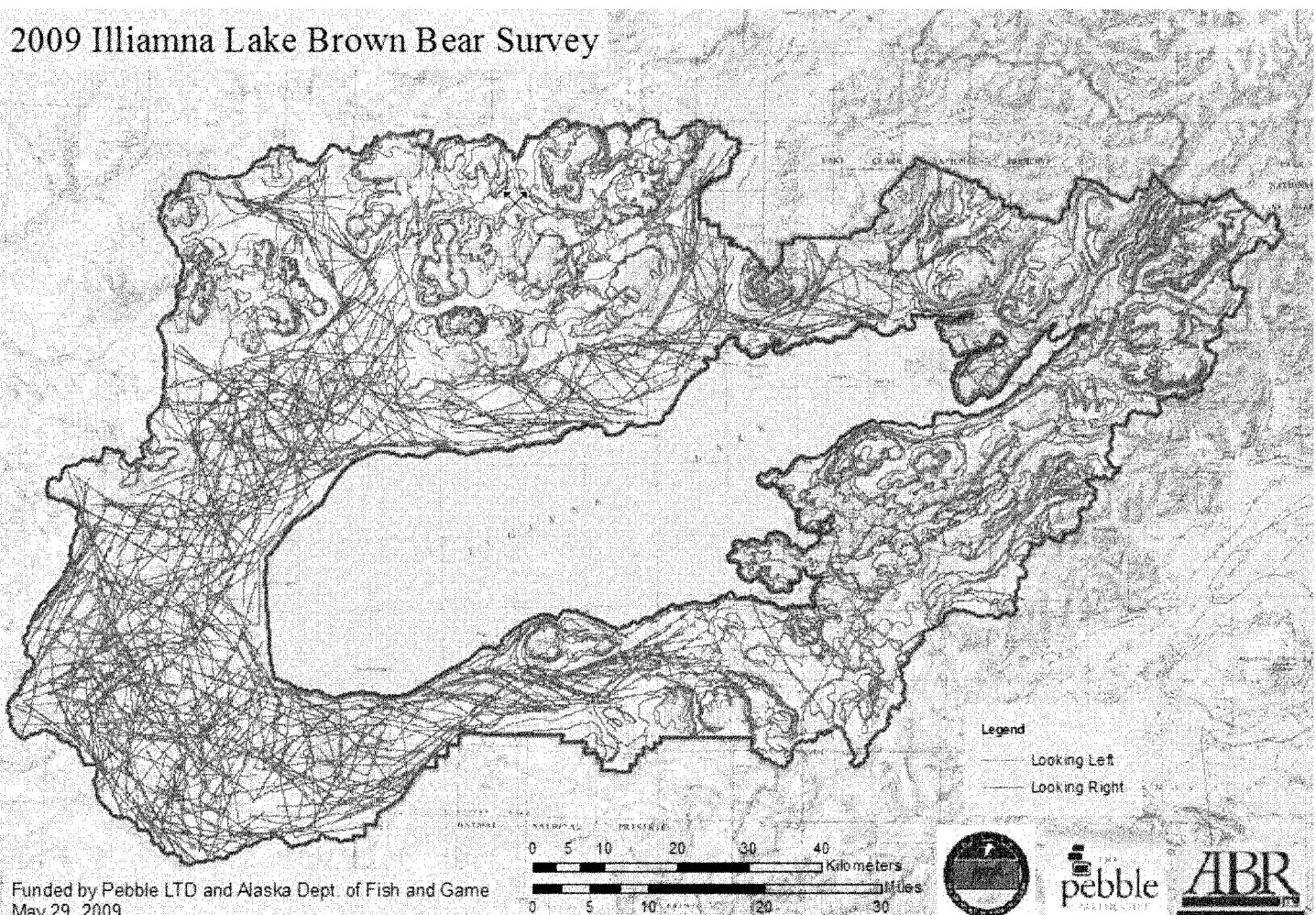


2009 Brown Bear Survey



EPA-7609-0005231-0085

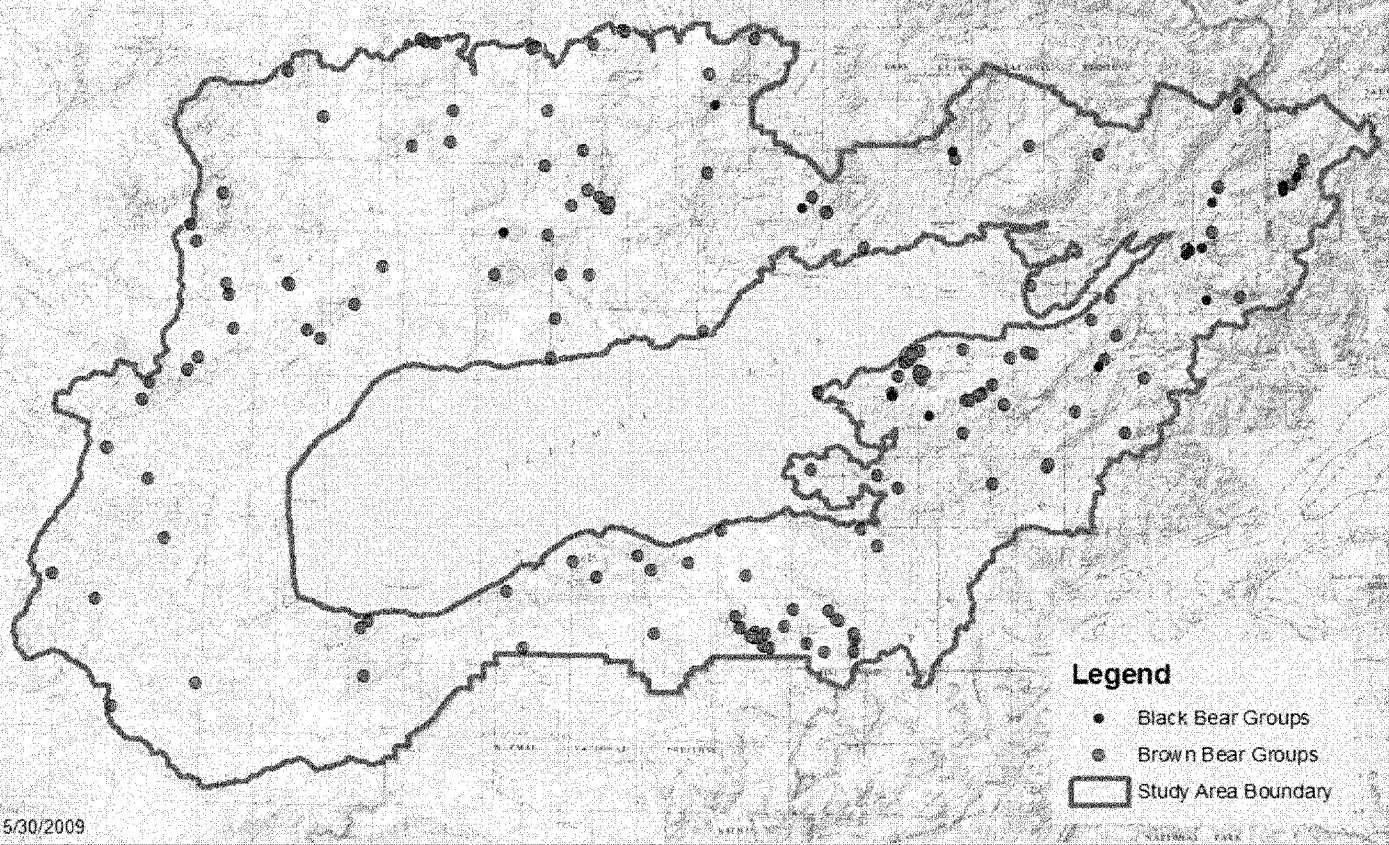
2009 Illiamna Lake Brown Bear Survey



Funded by Pebble LTD and Alaska Dept. of Fish and Game
May 29, 2009

EPA-7609-0005231-0086

2009 Lake Iliamna Bear Study



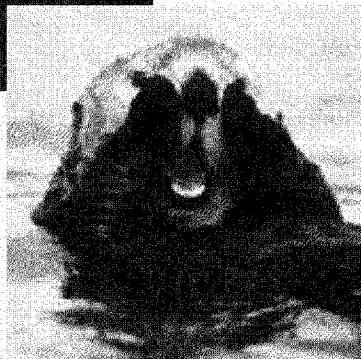
EPA-7609-0005231-0087



Marine Studies

Monthly aerial surveys

- Otters and Steller's Eiders
- Section 7 Consultation for Threatened & Endangered Species





Environmental Baseline Document

- 53 chapters
- 100+ sections & appendices
- 20,000+ pages
- 9,000 maps & figures
- Scheduled for completion July 2011



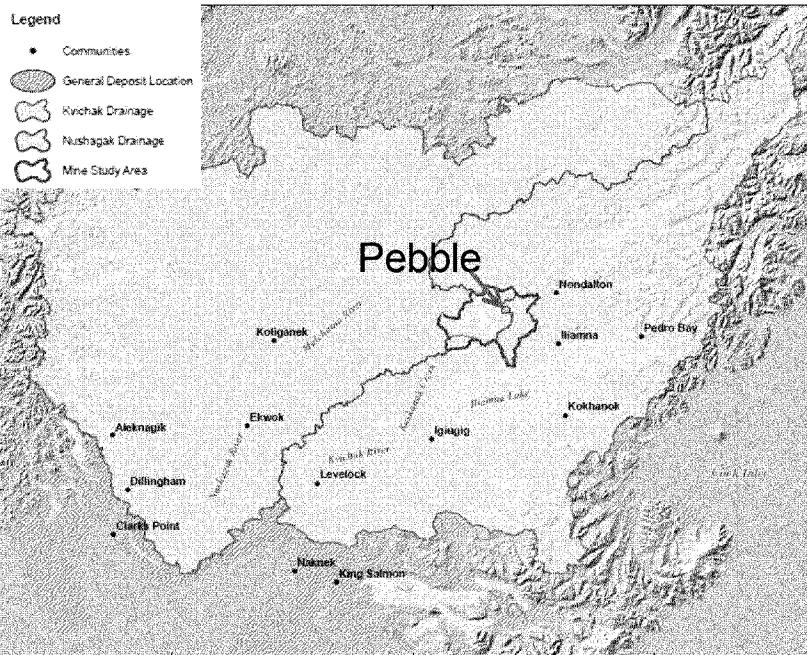
EPA-7609-0005231-0089



2011 Environmental Focus

- Complete and distribute EBD
- Contract firm to complete PFS Environmental and Social Impact Assessment
- Complete several management plans at PFS level required by Anglo Projects Way
- Complete PFS impact analyses:
- Flow reduction impacts
- Water quality seepage predictions
- Consultant/regulatory agencies meeting (fall)

Scope Matters



Bristol Bay Region
39, 184 sq. miles

State of Virginia
42,774 sq. miles

Nushagak River
12,735 mi² = Maryland

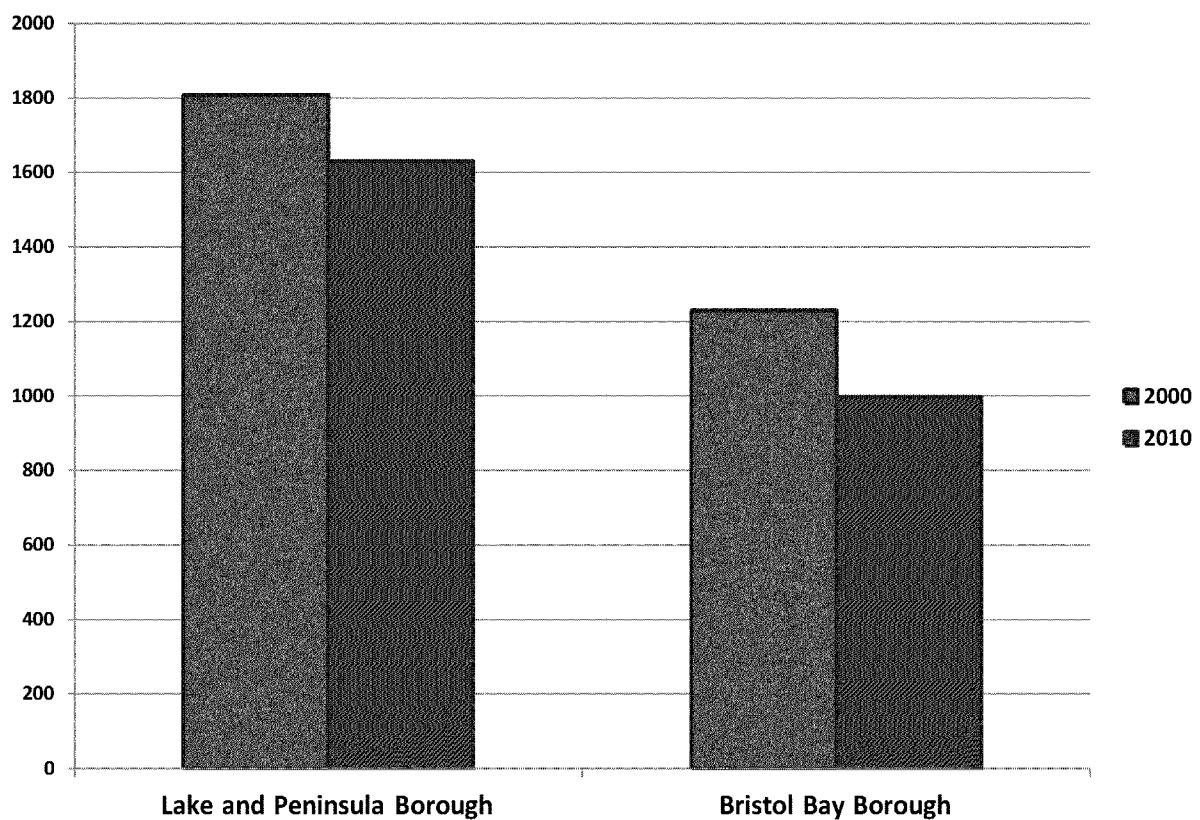
Kvichak River
8,017 mi² = New Jersey



EPA-7609-0005231-0091



Region Population



Source: US Census Bureau <http://www.census.gov/popest/counties/CO -EST2009-01.html>

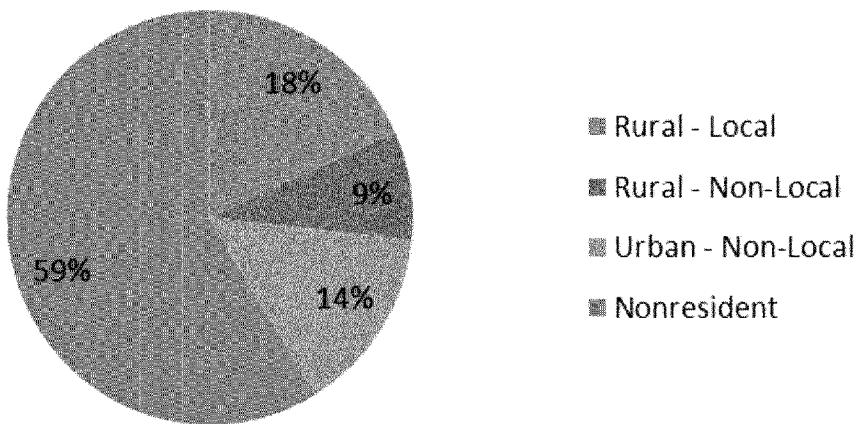
EPA-7609-0005231-0092



Bristol Bay Fisheries – Drift Net

All Permit Holders, All Districts

By Residency, 2009

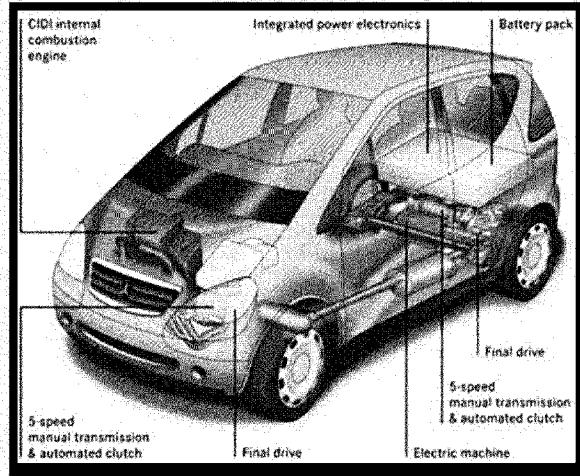
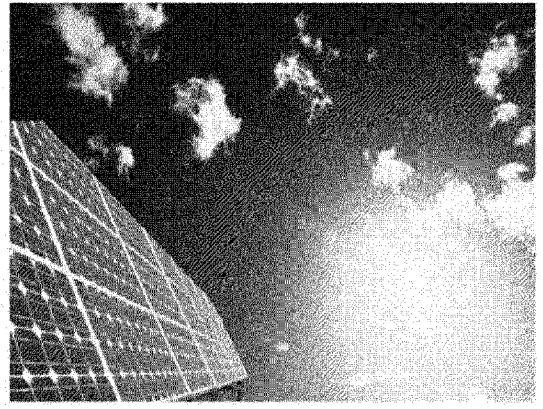


Bristol Bay 2009

- 1,610 registered drift net permits
 - 59% non-Alaskans



Copper – Building Block for Green Economy?



- Hybrid car nearly 2X the copper – 42lbs vs. 78lbs
- 3MW Wind turbine nearly 5 tons of copper
- Solar panels up to 60% copper

EPA-7609-0005231-0094